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Arlington, VA 22202-4501

Attention: Mr. Matthew Khan, Pesticide Re-Evaluation Division

Subject: **Thiamethoxam Registration Review**
60-Day Comments by Syngenta in Response to the Thiamethoxam Biological Evaluation Posted 8/26/2021
Case Number: 7614
Docket Number: EPA-HQ-OPP-2021-0575

Dear Mr. Khan:

On August 26th, 2021, the EPA published a Notice in the Federal Register announcing the availability of the Biological Evaluation for Thiamethoxam (case number 7614). With this notice, the Agency opened the 60-day public comment period. Syngenta reviewed the associated documents posted to the docket and Syngenta is providing the enclosed comments with the goal towards insuring accuracy, clarity and transparency.

Syngenta appreciates the opportunity to provide comments to the Thiamethoxam Biological Evaluation docket for Agency consideration. If you have any questions or comments regarding this response, please contact me at 336-632-2446 or by e-mail at Charles.Levey@syngenta.com.

Sincerely,

Charles Levey
Federal Team Lead, Insecticides
Regulatory Affairs Department
Syngenta Crop Protection, LLC

Syngenta Response to the Draft Thiamethoxam Biological Evaluation

1 Executive Summary

Syngenta would like to commend EPA for revising and improving the "Method for National Level Listed Species – Biological Evaluation of Conventional Pesticides". When reviewing the draft Thiamethoxam Biological Evaluation (BE), there are areas for further refinement and improvement that need to be updated in the final BE. These changes include consideration of how products are used in agricultural and non-agricultural settings, label mitigations and stewardship practices. In the following sections we will address areas for further refinement and improvement. We also plan to submit additional supporting data as EPA finalizes the draft Thiamethoxam BE.

Biological Evaluation Process and Improvements for the Consultation Process: As EPA continues to improve the BE process, the large number of Likely to Adversely Affect (LAA) listed species and critical habitats, as well as indirect effects, needs to be addressed through improvements in risk assessment, mitigation and enhanced tools and models. The long-term goal should be to increase efficiency and shorten the timelines for the Section 7 Consultation process. This will allow certainty for growers and other organizations who rely on pesticides to manage pests, while ensuring protection for listed species and critical habitats.

Species Data, Use Sites and Usage Data: EPA uses several spatial and nonspatial data sets for species and use site representations and usage in the LAA determinations for listed species and critical habitats. In many instances, the most recent species data were not used, e.g., changes in areas of range and critical habitat were not incorporated, or species that were delisted were included in the BE, or information on species attribute data related to habitat restrictions (e.g., elevation), or species that are only known to reside on uninhabited islands were not incorporated in the draft BE process. Spatial data representing use sites for several uses were significantly overestimated; this combined with assumptions used in estimation of percent crop treated (PCT) resulted in over-prediction of treated acres. An example of overestimation was in aggregating 5 Crop Data Layer classes to represent Alfalfa Use Data Layers (UDL) resulting in an over estimation by about 800% of the spatial extent of alfalfa potential use areas. Another example of the UDL to represent thiamethoxam uses on poultry litter is by far the most unrealistic representation of potential use sites. The poultry litter UDL generated by aggregating 9 crop UDLs (corn, soybeans, other grains, cotton, wheat, rice, other row crops, vegetables and ground fruit and alfalfa) on all counties with poultry operations resulted in a total crop footprint that was 9,520 times the area potentially available for poultry litter application, when compared to 500 pounds of annual usage data and conservatively lowest rate assumption. In addition, several errors in the UDL representation were identified, including the multi-crop UDLs for "Vegetables and Ground Fruit" and "Other Orchards". Another error was adding the UDL 100 "other crops" since there were not any matching labeled crop uses with these UDL groups. Another area of overestimation was the determination of PCT from usage data for agricultural uses, particularly those UDLs represented by multiple UDLs and/or those that allow multiple application rates. Also, the assumption of 100% PCT for non-agricultural uses resulted in unrealistically large number of treated areas. We demonstrate how the usage data were not properly accounted for the species LAA determination, and most importantly how the LAA determinations were based on incorrect potential use site representations. We provide recommendations on how to address the current errors in the analysis approach to better reflect the impacts of both conservative and expected usage scenarios on listed species.

Tools Used in the Biological Evaluation: Specific tools used by EPA in Step 1 and Step 2 were evaluated to understand how the LAA results were derived.

MAGtool v2.3.1 – There are difficulties in making the MAGtool a user friendly, transparent, efficient, and scientifically consistent tool for use in BE development. MAGtool model conservatism should be quantitatively evaluated in a Science Advisory Panel (SAP) to ensure that the model is identifying listed species and or critical habitats where adverse effects are identified while using the best available data. Without this effort, the evaluation burden is being shifted to the Services as most listed species and critical habitats that enter the BE process will continue to require consultation whether they may be at potential risk, or not. In addition to requiring additional time and resources by the Services to evaluate a broader list of species and habitats, the efficiency, transparency, and the scientific robustness of the entire process will continue to be questioned.

Plant Assessment Tool (PAT) - The PAT is used to estimate exposures to plants in terrestrial habitats in the draft Thiamethoxam BE. Thus, the PAT results were a critical component in the analysis plans and had a significant impact in making NLAA/LAA decisions. PAT, and especially the terrestrial module, should go through a Science Advisory Panel (SAP) review. In addition, the scientific community and all stakeholders should be given the opportunity to review and test PAT before it is used in Biological Evaluations supported by the EPA. We would propose that conference/workshop presentations are inadequate to validate the scientific integrity of a new model.

Exposure Refinements: Use of monitoring to benchmark model-estimated surface water concentration should be an integral part of the BE framework. As is acknowledged by the Agency, modeled EECs overrepresent likely environmental exposure. The impact of this conservative approach propagates throughout the evaluation and ultimately exaggerates the number of listed species designated as LAA. For thiamethoxam, detects in surface water (streams, wetlands, and a farm pond) ranged from below LOQ to ~2 ppb. These values are only comparable to the lower bound estimates reported in the draft BE for high flow aquatic bins and well below the 30-years of daily maximum values for use in the MAGtool.

Syngenta recommends the Agency use thiamethoxam-specific foliar dissipation rates (DT50) instead of the default 35-day value. Using studies containing leaf residue data where foliar applications of thiamethoxam were made to crops that were previously submitted to the Agency and six additional studies being submitted in support of this analysis, Syngenta has determined mean foliar DT50 to be 3.3 ± 2.5 days.

Although foliar application scenarios were primarily used in the draft Thiamethoxam BE to cover seed treatment uses, Syngenta is reminding EPA that thiamethoxam seed treatment decline studies have been submitted. While there is currently not an input for seed treatment DT50 values in T-REX, these studies can be used to determine a DT50 for treated seeds for use as weight of evidence that long term exposure to residues on treated seeds is not consistent over time.

The Agency uses the AgDRIFT model as a component of the MAGtool and PAT to estimate the contribution of exposure from spray drift of foliar applications. It has been shown that AgDRIFT tends to overpredict deposition especially in the far field. Therefore, Syngenta recommends the Agency consider published drift deposition data for thiamethoxam as an alternative to the AgDRIFT estimates to further refine environmental exposure predictions.

Clothianidin Endpoints: The Agency identified both thiamethoxam and its primary degradant clothianidin as residues of concern for terrestrial and aquatic organisms and used the lowest effects endpoints from either clothianidin or thiamethoxam studies as input values to the MAGtool. Clothianidin is more toxic than thiamethoxam to several terrestrial and aquatic taxa, leading to an overestimation of effects to listed species. Although Syngenta agrees that clothianidin can be considered a degradant of concern, the contribution of clothianidin from a thiamethoxam application for exposure to terrestrial and aquatic wildlife is relatively low, especially at the time of application. Therefore, Syngenta recommends that only thiamethoxam effects endpoints be used as input values to the MAGtool.

Direct Effects Refinements: Aquatic invertebrates outside the Class Insecta are less sensitive to thiamethoxam than aquatic insects. Sufficient data are available to generate a species sensitivity distribution (SSD). The HC05 for aquatic invertebrates outside the Class Insecta was determined to be 106.1 μg/L. Syngenta believes that adverse effects to listed aquatic invertebrates outside the class Insecta are not likely to occur and requests that the Agency re-evaluates how these species are assessed in the MAGtool with consideration of the HC05 for aquatic invertebrates outside the Class Insecta and exposure concentrations more reflective of those observed in available monitoring data.

Syngenta also recommends that the Agency use effects endpoints from closely related species when possible, to represent listed species taxa. The Agency used effects endpoints from the Eastern Oyster to represent all listed mollusks and used a separate input into the MAGtool for this Class. Effects data for the red swamp crayfish could be used in a similar way to represent all listed crayfish instead of defaulting to the HC05 for aquatic insects. Likewise, effects data are available for the monarch butterfly which could be used to represent listed Lepidopteran species more accurately.

Indirect Effects Assessment for Prey, Pollination, Habitat and Dispersion (PPHD): Compounding conservatism in the draft Thiamethoxam BE is a significant concern and likely the most important reason for many of the Likely to Adversely Affect decisions for indirect effects to listed species. Examples include conservativeness associated with listed species ranges and critical habitat, usage data within each species range and use of most sensitive effects endpoint and exposure estimates. Syngenta recommends the Agency consider the habitats required by listed species and the proximity of those habitats to thiamethoxam use patterns as well as the fact that dietary items and pollinators would also likely be in close proximity to the listed species and therefore impacts to PPHD would be minimal. Syngenta also recommends the Agency consider the unique diets of listed species. Taxa that constitute minor components of the listed species diet should not be modeled for effects in place of the primary food sources and methods to assess impacts to the PPHD of the listed species should be consistent.

Utilization of Conservation Measures and Stewardship Practices for Avoidance, Minimization and Mitigation: As outlined in the "Neonicotinoid Pesticide Draft Biological Evaluation Frequently Asked Questions", "EPA is considering additional mitigation measures, which may inform the final biological evaluation or the biological opinions. If the Services identify additional mitigation measures as part of formal consultation, they will include them in the biological opinions. Some of those measures may be tailored to the conservation needs of individual species, based on future discussions among EPA, the Services, and pesticide registrants." Syngenta has outlined several conservation measures for avoidance, minimization and mitigation that includes product label information and timing, equipment practices to minimize off-target movement, stewardship practices and conservation off-sets. We think these need to be considered during the formal consultation.

Also included in Appendix 1.0 is a Review of all three neonicotinoid BEs as prepared by Intrinsik and Stone Environmental (Teed et al. 2021). The focus of the review is related to the Revised Method, Use Data Layers, the MAGtool and PAT.

2 Biological Evaluation Process and Improvements for The Consultation Process

Syngenta would like to commend EPA for continuing to improve the "Revised Method for National Level Listed Species – Biological Evaluations of Conventional Pesticides". There are concerns that the Likely to Adversely Affect (LAA) numbers for listed species, critical habitats and indirect effects are quite high and puts an excessive burden on The Services during the formal consultation process of Step 3. EPA has acknowledged in the "Thiamethoxam Executive Summary for Draft Biological Evaluation" that "*Practically, the LAA threshold for a BE is very conservative as the likely "take" of even one individual of a species triggers LAA (even if that species is almost recovered). This often results in a high number of May Affect determinations in a BE. An LAA determination in the BE, however, should not be interpreted to mean that EPA has made a determination that thiamethoxam is putting a species in jeopardy. Those determinations are made in the course of Step 3 by the National Marine Fisheries Service and the Fish and Wildlife Service (referred to as The Services).*" As this process is revised and improved, it is important that EPA finds a more reasonable method for reaching LAA determinations that consider practices including label mitigations, stewardship best management practices and conservation off-sets prior to and included in Step 3.

3 Species Data, Use Sites and Usage Data

3.1 Species Data

3.1.1 Overview

The spatial data representing species' ranges and designated critical habitat that were used in the draft Thiamethoxam BE were downloaded in November 2020 from the US Fish and Wildlife Services (FWS) and the National Marine Fisheries Service (NMFS). Details of the spatial data are presented in Appendix 1-7 of the draft BE.

3.1.2 Critique of Data and Recommendations

3.1.2.1 Not using up-to-date range and critical habitat data

Species location data (ranges) and designated critical habitats included in the draft Thiamethoxam BE indicated that EPA used species data downloaded in November 2020. Several updates have been made to the spatial data for species range maps and critical habitats since EPA's download date. We acknowledge species data are constantly being updated, and by the time spatial analysis and effects determination are completed, the areas of species range and habitat and the species status for some species may be changed. Given the importance of the EPA's BE to the ESA process, there should be a mechanism to regularly update listed species information for incorporation into the BE process before their final release.

For example, 7 species (**Table 3.1.1**) that have LAA determination in the draft Thiamethoxam BE have been delisted due to recovery/error corrections, and therefore are not subject to ESA consultation. We recommend EPA conduct a quality control and check for any new updates (including delisted species) before the final BE is released.

Table 3.1.1 List of delisted species that should not be included in the thiamethoxam draft BE

Taxon	**Common (*Sci*) name**	**Sp. Id**	**Effects determination**	**Federal Notice for delisting date; No.[3]**
Mammals	Gray wolf (*Canis lupus*)	11/12	LAA[1]	Nov 3, 2020; 85 FR 69778
Birds	Least tern (*Sterna antillarum*)	134	NE	January 13, 2021; 86 FR 2564
Terrestrial Invertebrates	Kanab ambersnail (*Oxyloma haydeni kanabensis*)	400	LAA[1]	June 24, 2021; 86 FR 33137
Plants	Bradshaws desert-parsley (*Lomatium bradshawii*)	1225	LAA[1]	March 8, 2021; 86 FR 13200
Plants	No common name (*Lepanthes eltoroensis*)	956	LAA[1]	June 16, 2021; 86 FR 31972
Plants	Running buffalo clover (*Trifolium stoloniferum*)	1041	LAA[1]	August 6, 2021; 86 FR 43101
Plants	Florida golden aster (*Chrysopsis floridana*)	904	LAA[1]	June 21, 2021; 86 FR 33177
Plants	Water howellia (*Howellia aquatilis*)	1047	LAA[2]	June 16, 2021; 86 FR 31955

[1]Moderate evidence of LAA

[2]Weakest evidence of LAA

[3] all were delisted due to recovery, except 'Kanab ambersnail' was delisted due to original data in error - Not a listable entity

In addition, several updates on the spatial data for species range maps and critical habitats have been made since June 2020. Based on the FIFRA Endangered Species Task Force ("FESTF") spatial area comparisons done on species ranges and critical habitats downloaded from USFWS ECOS

(Environmental Conservation Online System), there were significant changes to the areas of range and critical habitats between a variety of downloaded date ranges. For example, for range maps downloaded between June 2020 to April 2021, areas for about 68 species ranges with LAA determination have been decreased while areas for 14 species ranges with LAA determination have increased (**Appendix 2.1**). For critical habitat (CH) downloaded in the same period, the areas for about 23 species with LAA determination have been decreased while areas for about 12 species with LAA determination have increased (**Appendix 2.2**). While we were not able to conduct species overlap analysis and assess their impacts, we anticipate these changes could impact results of percent overlap (species and use sites) and potentially on the associated effects determinations and/or strength of LAA conclusions. Moreover, if updated species maps and critical habitat are not used in the final BE, these could create inconsistencies and inefficiencies when the Services are evaluating the BE materials and making their Biological Opinion. Thus, we recommend EPA use the most up-to-date species range and critical habitat data in the final BE.

3.1.2.2 Incomplete use of species attribute data

Species, found in uninhabited islands (areas) where pesticide exposure is negligible or is not anticipated, should be considered for the unlikely to be exposed determination (incomplete exposure) in Step 2a. Based on species attribute information from FWS, we found 21 species with LAA determination in the draft BE that are only known to occur on uninhabited islands (**Table 3.1.2** for the list of species). We recommend EPA use the best available information data from FWS to identify more species that may only be known to occur on uninhabited areas and use this information as weight of evidence for unlikely to be exposed considerations.

Table 3.1.2 Species identified by FWS that are only known to occur on uninhabited islands

Taxa	Common Name	Scientific name	Species ID
Birds	San Clemente loggerhead shrike	*Lanius ludovicianus mearnsi*	115
Birds	San Clemente sage sparrow	*Amphispiza belli clementeae*	116
Reptiles	Mona boa	*Epicrates monensis monensis*	164
Reptiles	Mona ground Iguana	*Cyclura stejnegeri*	165
Plants	Santa Rosa Island manzanita	*Arctostaphylos confertiflora*	503
Plants	Soft-leaved paintbrush	*Castilleja mollis*	524
Plants	Santa Cruz Island dudleya	*Dudleya nesiotica*	543
Plants	Island bedstraw	*Galium buxifolium*	552
Plants	San Clemente Island woodland-star	*Lithophragma maximum*	571
Plants	Santa Cruz Island bush-mallow	*Malacothamnus fasciculatus var. nesioticus*	574
Plants	Island phacelia	*Phacelia insularis ssp. insularis*	587
Plants	Lo`ulu	*Pritchardia remota*	598
Plants	Santa Cruz Island rockcress	*Sibara filifolia*	609
Plants	San Clemente Island Indian paintbrush	*Castilleja grisea*	657
Plants	San Clemente Island larkspur	*Delphinium variegatum ssp. kinkiense*	694
Plants	Santa Barbara Island liveforever	*Dudleya traskiae*	698

Table 3.1.2 Species identified by FWS that are only known to occur on uninhabited islands			
Taxa	**Common Name**	**Scientific name**	**Species ID**
Plants	San Clemente Island lotus (=broom)	*Acmispon dendroideus var. traskiae (=Lotus d. ssp. traskiae)*	760
Plants	San Clemente Island bush-mallow	*Malacothamnus clementinus*	762
Plants	Higo Chumbo	*Harrisia portoricensis*	942
Plants	Santa Cruz Island fringepod	*Thysanocarpus conchuliferus*	1011
Plants	Santa Cruz Island malacothrix	*Malacothrix indecora*	1130

3.1.2.3 A Need for Refined Species Range and Critical Habits Spatial Maps

To have informative overlap analysis results, and to better inform where the species might be in relation to use sites where a pesticide may be applied, it is critical to develop more refined species ranges and critical habitat limited by suitable habitat factors, including elevation and other soil and climatic factors. For critical habitats in particular, the spatial location used in the overlap analysis needs to be limited to where physical and biological features/ primary constituent elements (PBFs/PCEs) occur within the spatial boundary of the critical habitat and not simply an overlap analysis using spatial data as EPA has completed in the draft BE.

> *"Under section 7(a)(2) of the Endangered Species Act, federal agencies must ensure that their actions do not destroy or adversely modify critical habitat. PBFs provide a basis on which agencies and the Service may evaluate how actions are likely to affect critical habitat."*

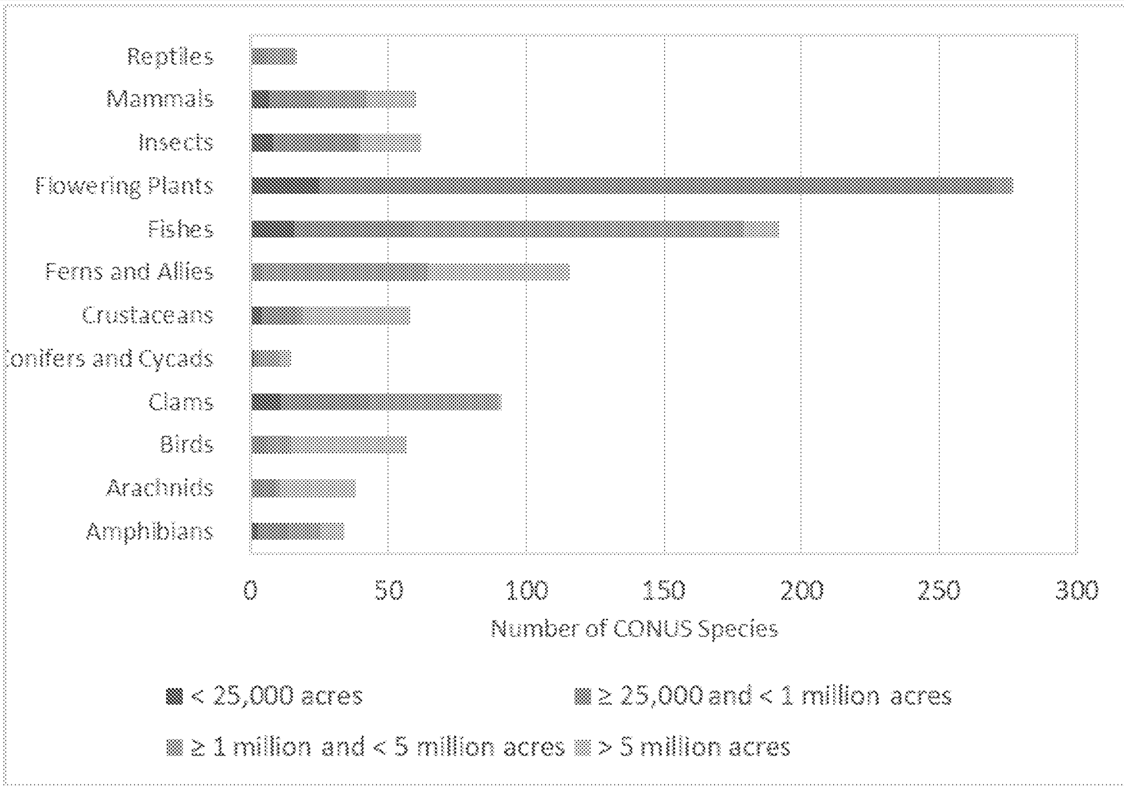
For most species, critical habitat designation published in the *Federal Register* by FWS describes the location and boundaries of the critical habitat and its essential physical and biological features (PBF). The use of refined locations of species ranges and critical habitat is particularly important when species ranges, and critical habitat cover broad geographic areas.

For example, ranges of species evaluated in the Thiamethoxam draft BE vary greatly in resolution and size, from less than one acre (narrow ranges) to a wide range of over 900 million acres sizes (per data downloaded in 2021 from USFWS). More than half of the CONUS (contiguous United States) listed species ranges cover close to 50% of the total land acres in the continental US, and the vast majority, approximately 93%, have a range size that is ≥ 25,000 acres (**Table 3.1.3** and the associated figure for species range distribution among different taxonomy). Variation of range sizes could be due to many reasons including the nature of the species' biology, uncertainty in the extent of the species range, species mobility, and availability of data. Wide ranges for many species may be considered unreliable because the span of such a large contiguous area indicates uncertainty in where the species occurs or could potentially occur. An overlap analysis using geospatial analysis may not provide meaningful information if such coarse species range data with so much uncertainty are used as an input. Thus, there is a great need for species refinements and consideration of habitat factors limitations to better inform where species may potentially reside in relation to use sites. The FWS's release of Standard Operating Procedure for species distribution models (SDMs) generation (Moskwik, et. al., 2019) and plans to use these SDMs to refine range maps for wide ranging species are positive steps in having more refined species maps.

Table 3.1.3 The percent of species in various range sizes categories for FWS species currently available for CONUS

Range size (acres)	Number of Species	% of Total FWS Species
< 25,000	75	7
≥ 25,000 and < 1 million	418	41
≥ 1 million and < 5 million	295	29
≥ 5 million	229	23

Percent of Total CONUS FWS Species in different Range Sizes



3.2 Spatial Data Used to Represent Potential Use Sites

3.2.1 Overview

Use Data Layers (UDLs) are used to spatially represent application sites for agricultural and non-agricultural label uses in EPA's Endangered Species Biological Evaluations (BEs) (EPA, 2021; Appendix 1-5 and Appendix 1-6). EPA used USDA's Cropland Data Layer (CDL) for the agricultural use sites found in the contiguous United States (CONUS). CDL is satellite imagery produced by the U.S. Department of Agriculture (USDA, 2019) and spatially characterizes specific agricultural crops in the CONUS. For agricultural uses, EPA generated agricultural UDLs from 5 years of the CDL, 2013-2017. EPA grouped over 100 cultivated CDL land classes into 13 UDLs (**Table 3.2.1;** and APPENDIX 1-5 of draft BE). After aggregating CDL, EPA's methodology included mechanisms to expand UDL pixels until acreage reported by USDA's 2012 Census of Agriculture (USDA-NASS, 2017) was attained. The USDA-NASS Census of Agriculture (CoA) is a national survey conducted every five years which reports county-level farm counts and acreage by crop type. Finally, the UDL spatial layers represented the application sites for labeled uses (or chemical action area).

Table 3.2.1 Use Data Layers (UDL) included in the of EPA draft thiamethoxam BE and the spatial analysis tool

UDL Class Code	UDL Class Description	Number of CDL Classes Included
20	Cotton[a]	4
40	Soybeans[a]	6
60	Vegetables and ground fruit[a]	42
70	Other orchards	16
71	Vineyards/Grapes	1
72	Citrus	2
80	Other Grains[a]	21
90	Other Row Crops	5
100	Other Crops[b]	5
	Poultry litter UDL	
10	Corn[a]	6
40	Soybeans[a]	6
80	Other Grains[a]	21
20	Cotton[a]	4
50	Wheat[a]	6
30	Rice	1
90	Other Row Crops	5
60	Vegetables and ground fruit[a]	42
110	alfalfa/agricultural grasses/pasture	5

[a] UDLs for corn, cotton, soybeans, wheat, vegetables and ground fruit, and other grains include associated double crop CDLs.

[b] UDL 100 includes 5 CDL groups (CDL 44 [Other Crops], CDL 58 [Clover/Wildflowers], CDL 59 [Sod/Grass Seed], CDL 61 [Fallow/Idle Cropland], CDL 92 [Aquaculture])

3.2.2 Methodology and Recommendations for Improvement

3.2.2.1 Not using the most up-to-date data, resulting in lack of using best available data

Appendix 1-6 of the draft BE indicates that the 2012 USDA CoA was used to augment the development of UDLs. Information from the 2017 CoA is available and needs to be incorporated into the final BE as the best available data. Additionally, Appendix 1-6 of the draft BE indicated that 5-year CDL data from the period of 2013-2017 were used in the draft BE. However, CDL data are produced every year, and more recent data are available (including 2018, 2019, 2020, and 2021); however, these data were not included in the draft Thiamethoxam BE. As much as possible, the most recent CDL data should be incorporated into the use site generation because the agricultural landscape can change significantly in a 3–4-year period.

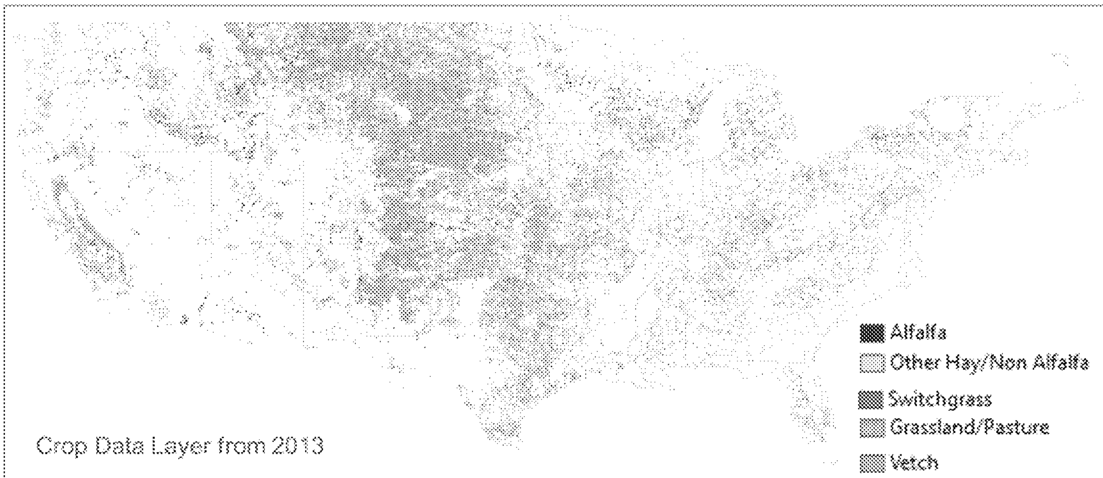
3.2.2.2 Aggregating 5 Crop data layer classes to represent Alfalfa Use Data Layers (UDL), Results in Over-estimation of the spatial extent of alfalfa potential use areas

Alfalfa uses are part of thiamethoxam registered seed treatment uses. In addition, alfalfa UDL is one of the nine crop UDLs aggregated by EPA (**Table 3.2.1**) to generate poultry litter UDL spatial representations.

In the draft Thiamethoxam BE, it is not clear which CDL classes are aggregated to create the UDL 110 to represent alfalfa uses. For example, in Table 2 of Appendix 1-5 ("Cross-walk between CDL class and UDL agricultural classes"), it indicates that UDL 110 representing alfalfa and agricultural grasses was created by aggregating CDL 36 (alfalfa), CDL 60 (switchgrass), and CDL 224 (Vetch). On the other hand, in the "Spatial Analysis Tool" used to generate CDL to UDL processing and action area Python Scripts, it indicates that UDL 110 (alfalfa/pasture grass) was created by aggregating five CDL classes: CDL 36 (alfalfa), CDL 60 (switchgrass), CDL 224 (Vetch), CDL 37 (hay/non alfalfa), and CDL 176 (grassland/pasture).

Using a UDL 110 from aggregated five CDL classes (i.e., CDL 36 (alfalfa), CDL 60 (switchgrass), CDL 224 (Vetch), CDL 37 (hay/non alfalfa), and CDL 176 (grassland/pasture) to represent alfalfa uses massively overestimates the spatial extent for alfalfa potential use areas (see **Figure 3.2.1**).

Figure 3.2.1: Crop Data layers from CDL 2013 included in the UDL 110 groupings



For comparative purposes, from CDL 2013 (**Table 3.2.2**), we present the acres of each CDL class that would be included in the UDL 110; and as shown in the table alfalfa and other grasses constitute only 10% of the total areas in UDL 110. In other words, the CDL 176 class represents about 90% of the aggregated area in the UDL 110. We understand that the CDL data used in this example may not exactly match with the data that EPA used, however, we assume the overall proportion of CDL classes in UDL 110 would be relatively similar. The majority of the UDL 110 is covered by pasture/grassland (CDL 176), and hence including it to the alfalfa UDL will overestimate the spatial extent of potential use areas. An overly extensive action area based on an over-sized UDL will lead to an unrealistic level of overlap between potential use sites and the species.

Table 3.2.2 CDL 2013: Areas of CDL data layers in CONUS grouped into the UDL 110

CDL	CDL class	UDL group	Area Acres (%)
224	vetch	UDL 110	3,727 (0.001%)
37	switchgrass	UDL 110	20,034 (0.005%)
36	alfalfa	UDL 110	15,204,055 (3.9%)
37	hay/non-alfalfa	UDL 110	29,012,944 (6.7%)
176	pasture/grassland	UDL 110	386,872,727 (89.7%)
	Total Areas of UDL 110		431,113,488

Recommendations: We believe that alfalfa CDL should be used to map (or geographically represent) thiamethoxam labeled alfalfa uses, whether as part of the crop layer for poultry litter soil amendment or any other uses (e.g., seed treatment). Alfalfa is a good example of a crop that qualifies as a single-crop UDL based on its data accuracy provided by the United States Department of Agriculture (USDA). The USDA provides detailed accuracy assessment tables for the CDL by year (& crop) nationally, starting in 2016 (as well as per state dating back to 2008). Within the accuracy tables, accuracy-derived bias is calculated as negative one plus the ratio of producers to user's accuracy or ratio of 'errors of omission and commission' (Lark et al. 2017). A negative bias implies that the CDL is underestimated, and a positive bias implies that the CDL is overestimated. In addition, the lower the bias (absolute values), the higher the confidence that CDL classes represent real-world conditions, and vice versa. As shown in the **Table 3.2.3**, the bias for alfalfa (-3.6%) is within the range of bias provided for corn and cotton, crops qualified by EPA for individual crop UDL (corn has a -4.92% bias; cotton has a -1.4%).

This indicates that the accuracy of alfalfa is similar to corn and cotton, thus qualifies for a single-crop UDL to be generated from the CDL 36 (alfalfa). In addition, when additional datasets are needed to validate and improve the base CDL data using CoA the USDA provides the coefficient of variation (CV), a measure of uncertainty of an estimate, for CoA data (USDA NASS 2017). The magnitude of the CV is directly related to the reliability of the estimate – as the CV increases, the estimate decreases in reliability. Together with accuracy-derived biases from the CDL, CVs of CoA can be used to corroborate which CDL classes have high confidence in their ability to represent a given labeled use area without having to be grouped with other classes to account for uncertainties. In summary, based on its accuracy-derived biases from the CDL and lower CV for its CoA data, alfalfa is best represented by a single-crop UDL derived from CDL 36. At minimum, alfalfa should be represented by the UDL 110 by excluding the CDL 176 class (pasture and grassland).

Table 3.2.3 National accuracy bias from the accuracy assessment tables in the Cropland Data Layer (CDL) and coefficient of variation from the Census of Agriculture for single-crop Use Data Layers (UDLs)

Crops	UDL Assignment by EPA	CDL Accuracy Assessment (2017)	Census of Agriculture (2017)
		Bias	Coefficient of Variation (CV)
Alfalfa	UDL 110	-3.6%	2.1
Corn	UDL 10	-4.9%	1.2
Cotton	UDL 20	-1.4%	2.8

3.2.2.3. Poultry litter UDL generated to represent thiamethoxam uses on poultry litter is the most unrealistic representation of potential use sites.

For representing the potential spatial extent for thiamethoxam uses on poultry litter, as stated in Appendix 1-6, EPA assumed poultry litter to be applied to 9 crop UDLs (corn, soybeans, other grains, cotton, wheat, rice, other row crops, vegetables and ground fruit and alfalfa; **Table 3.2.1**) of 24 crops listed for potential manure application in Kellog et al. (2000). The spatial extent for representing the poultry litter application footprint was generated by first aggregating the UDLs associated with these crops and limiting aggregated UDL to the counties identified with potential poultry operations from the USDA National Agricultural Statistics Service (USDA-NASS, 2019). The draft BE states that the resultant poultry litter UDL representing national level poultry litter spatial footprint was used in the overlap analysis with species. The poultry litter UDL represents an overly extensive action area based on aggregations of multiple UDLs, this potentially led to an unrealistic level of overlaps between potential use sites and the species.

The following are key uncertainties and issues identified with this poultry litter UDL.

- All crops listed in Kellog et al. (2000) are assumed to receive poultry litter application, which inaccurately assumes the availability of the poultry litter and application rates as non-limiting factors
- Uncertainties of Alfalfa UDL (which included pastureland) included as part of poultry litter UDL (see above notes on alfalfa UDL)

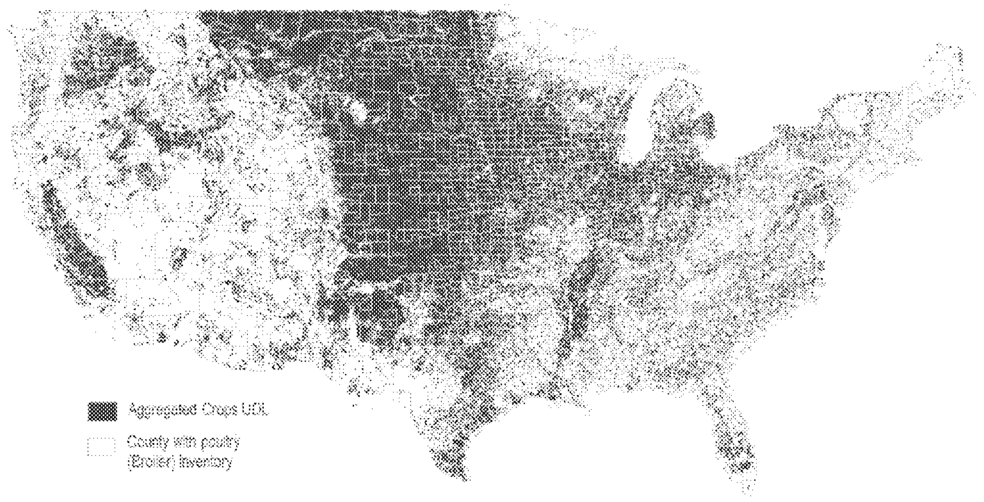
- Aggregating multiple crop UDLs, covering major crops and vast geographic areas, to represent poultry litter UDL, and lack of any mechanism to ground truth the acres represented by the poultry litter UDL

We understand, the Agency has acknowledged many of the uncertainties associated with the poultry litter UDL; nevertheless, we present a detailed review by focusing on the last uncertainty item associated with the poultry litter UDL.

Appendix 1-6 of the draft BE has general descriptions of the methodology used to develop a national-level poultry litter spatial footprint (poultry litter UDL) using: 1) nine UDLs crop footprint from the list of 24 crops reported in Kellog et al. (2000) that were identified for possible poultry litter application, and 2) the counties identified with potential poultry operations. However, the methodology does not provide the total area represented in the poultry litter UDL. The report by Kellog et al. (2000) not only includes the estimated poultry (livestock) populations and quantities of manure produced from the census of agriculture but also provides the acreage of farmland available for manure application from various livestock operations. For the years 1982–1997, the report identifies a total of 4.671 million acres of farmland (constituting 24 crops and grassland) available nationally for manure application on poultry operations with confined animals. This is key information that the Agency should have considered. If one assumes a hypothetically worst-case scenario that all poultry litter produced from all poultry operations with confined animals were treated with thiamethoxam, then, areas represented by poultry litter UDL in the draft BE should not have exceeded 4.671 million acres of total areas reported to be available for poultry litter application. In the EPA methodology, it appears that additional ground truthing should be done to the poultry litter UDL acreage versus any realistic acreage of farmland areas available for poultry litter applications. The poultry litter UDL data lack a validation mechanism and raises questions on the validity of the BE assessment done for these uses.

To demonstrate the extent of the poultry litter UDL area that EPA used in the draft BE, we developed an aggregated UDL of crops per the methodology and limited this aggregated UDL by the county with known poultry operations from the 2017 census of agriculture USDA-NASS (2019). For this example, due to time limitation, we used data from poultry broiler operations only. We included counties with data "with D abbreviations" ("withheld to avoid disclosing data for individual operations") in determining the spatial footprint. We understand that the 2014-2018 CDL data used to create the poultry litter UDL and the 2017 census county data with only poultry broiler operations may not exactly match with EPA's data layers used, however, we presume the overall extent would be relatively similar. **Figure 3.2.2** shows the extent of the aggregated UDL generated to represent poultry litter applications and counties with potential poultry operations.

Figure 3.2.2 Map showing overlay of aggregated UDL generated to represent poultry litter applications and counties with potential poultry operations.



From this example map (**Figure 3.2.2)** the areal extent of poultry litter UDL is very extensive. The area under the poultry litter UDL is estimated to be about *680 million acres*. To help make comparisons, about 4.671 million acres of farmland was estimated to be available for poultry litter applications by Kellog et al. (2000), and as indicated in Appendix 1-7 of the draft BE, the total agricultural crops acreages estimated to have received thiamethoxam applications (foliar and soil) were over 3 million acres annually. Thus, these comparisons of areas indicates that the poultry litter UDL that is assumed to be potentially available for poultry litter application is unrealistically large.

Recommendations: With all the uncertainties involved specific to the poultry litter UDL, an overlap analysis of this UDL and listed species results in inaccurate results related to proportion of species range and critical habitat that may be exposed to thiamethoxam, even with the default 2.5% PCT (percent crop treated) applied to adjust the overlap analysis. Note that 2.5% of the 680 million acres is still about 17 million acres. Thus, we recommend that the poultry litter UDL be updated in the final BE:

1) the total areas of poultry litter UDL should not exceed the 4.671 million acres of total farmland (assessed to be available for poultry litter application per Kellog et al. (2000)), and
2) a PCT reflecting the available usage information should be used in lieu of the 2.5% PCT used by EPA for the poultry litter UDL. Using the information from thiamethoxam SUUM usage data that <500 pounds were reported to be applied per year to “livestock pens and poultry houses” (see below for details of PCT calculation for poultry litter UDL).

3.2.2.4. Not clear what thiamethoxam uses are represented by the UDL 100 (other crops) that are included in BE

In the draft Thiamethoxam BE, it is not clear what thiamethoxam uses are represented in the UDL 100 (named other crops). As shown in **Table 3.2.1**, UDL 100 includes 5 CDL groups, including CDL 44 [Other Crops], CDL 58 [Clover/Wildflowers], CDL 59 [Sod/Grass Seed], CDL 61 [Fallow/Idle Cropland], CDL 92 [Aquaculture]. It is not clear in the draft BE what labeled uses were supposed to be represented by the UDL 100. This UDL 100 is included in the BE analysis and determined by EPA to have impact on 404 species and is one of the top six UDLs representing the highest number of species being impacted. We believe this UDL 100 may have been included in the BE by error

Recommendations: Additional clarifications on why UDL 100 is included in the BE analysis and what thiamethoxam uses UDL 100 represents are necessary. Or if this UDL was included by error, it should be removed.

3.3.2.5 UDL representations for Multi-Crop UDLs, Including "Vegetables and Ground Fruit", "Other Orchards", and "Other Grains" May Substantially Over-Predict Potential Use sites within a Species Range

As shown in the **Table 3.2.1**, the number of crops (CDL) grouped into the UDL 60 "Vegetables and Ground Fruit", UDL 70 "Other Orchards", and UDL 80 "Other Grains" were 42, 16, and 21 CDLs, respectively (crop details are presented in the draft BE: Table 2 of Appendix 1-5). There are several crops that are included in these multi-crop UDLs that are non-labeled crops (i.e., not registered uses for thiamethoxam). The methodology applied in the draft Thiamethoxam BE representing potential use sites for multi-crop UDLs accounts for non-labeled crops that are part of the UDL by assuming a 0% PCT for those crops (EPA, 2021; Appendix 1-7 Section 2.1). However, the non-labeled crops that are part of a multi-crop UDL can comprise a significant portion of the UDL within the areas of species ranges. The impacts of having a UDL that is drastically larger than the area represented by potential use sites occurs before the consideration of usage data at Step 1a, when overlap between the action area and species range/critical habitat is evaluated. An overly extensive action area based on an over-sized UDL leads to an unrealistic level of overlap between potential use sites and the species. Later in Step 2, even when usage data are considered, the issue of an over-sized UDL consisting of primarily non-labeled potential use sites may lead to overestimation of treated acres within a species range/critical habitat, particularly when the species overlap is mainly the non-labeled crops.

Recommendations: The draft BE has provided some justification for the grouping of multi-crop UDL (EPA, 2021; draft BE Appendix 1-6: Section 1), with the primary justification being uncertainty in classification and multi-year variability. An alternative approach, that reduces the errors and uncertainty would be to constrain the crops included in a multi-crop UDL to thiamethoxam labeled uses. The classification uncertainty associated with individual CDL classes and concerns of low-biased CDL-based acreage estimates could be mitigated with the "region growing" methodology used by EPA to expand UDL pixels until acreage reported by USDA Census of Agriculture is attained. The region-growing methodology could be modified such that the growing region is constrained to the full multi-crop UDL footprint area. This approach would achieve the targeted UDL acreage of labeled uses and remain spatially consistent with best available data describing the locations of these labeled crops, without over-inflating the extent of potential use sites or treated acres. In addition, accuracy data available from the CDL metadata could be used to develop a spatially explicit probability distribution of land cover and changes as suggested in the National Academy of Sciences (2013) report. The work of Budreski et al. (2015) provides an example of a comprehensive approach for addressing both crop rotations and data uncertainty when developing UDLs.

3.3 Determination of Percent Crop Treated (PCT) from Usage Data

3.3.1 Overview

Percent crop treated (PCT) is determined from usage data to help adjust the extent of the potential use areas overlapping with a listed species' range (or critical habitat), and to represent the more likely extent of overlap that is directly treated with thiamethoxam. In order to determine the PCT, the analysis for thiamethoxam integrates information on potential use sites and usage data (EPA, 2021; Appendix 1-7, Section 2.1).

Thiamethoxam usage data incorporated into the BE are summarized in the usage data for Thiamethoxam SUUM (EPA, 2021; Appendix 1-4). Appendix 1-4 documents agricultural and non-agricultural thiamethoxam uses at the state and national scales. The primary data sources for agricultural uses were Kynetec USA, AgroTrak, US Department of Agriculture National Agricultural Statistics Service (NASS), and the California Department of Pesticide Regulation (CDPR) Pesticide Use Reporting (PUR) database. For non-agricultural uses, the primary data source was proprietary survey data compiled by Kline and Company.

Depending on data availability, the usage data are reported by use site/state. For example, agricultural usage data may be reported independently for soybean, cotton etc., while non-agricultural usage data may be reported on a national level for turf grass lawn and around building premises. Based on the usage data (EPA, 2021; Appendix 1-7), during the most recent five years of available survey data (2014 -2018), over 185,000 pounds of thiamethoxam were applied to over 3 million acres of agricultural crops annually (**Table 3.3.1**). Approximately 49% of those pounds of thiamethoxam applied on agricultural crops were reportedly made to two crops (cotton, and soybeans); and with respect to total acres treated, approximately 67% of the total acres treated with thiamethoxam were planted with cotton and soybeans. Conversely, quantitative seed treatment usage data were difficult to obtain due to the complexities of capturing this usage information from growers.

Table 3.3.1 Summary of thiamethoxam usage data taken from Appendix 1-7 and Appendix 1-4 of draft BE

Crop/ Use areas	Estimates of average annual pounds	Total Acres treated
Agricultural crops cotton and soybeans other crops	> 185,000 90,650 94,350	> 3 million 2,010,000 990,000
Turf grass uses	No data	No data
Building premises and contents	<2000	No data
livestock pens and poultry houses	<500	No data
Seed treatment uses	No data	No data

Data related to non-agricultural usage is more limited compared to agricultural usage data. However, available survey data indicates that less thiamethoxam was applied annually on non-agricultural sites than the agricultural sites (Appendix 1-7). The national non-agricultural thiamethoxam usage data (Table 3 of draft BE Appendix 1-4) also indicated <500 pounds usage annually for 'livestock pens and poultry houses'.

The extent and variability of usage at a use site/state level are reported in the draft BE using minimum, maximum, average percent crop treated (PCT) over five-year observation period. PCT is calculated as the percent of acres grown for a crop that are treated with the active ingredient. These PCT values are then used to adjust the overlap area of the UDLs with the range and critical habitat area for each species (EPA, 2021; Appendix 1-7, Section 2.1). The state-level estimates of pesticide usages expressed as PCT are thus used to inform estimates of the proportion of a species range that may be exposed to the active ingredient.

Key assumption of this PCT approach in the draft BE include:

1) no multiple applications to the same fields (or doesn't account for multiple applications to the same fields).
2) a threshold value of 2.5% PCT with no justification was selected for the poultry litter UDL.
3) 100% PCT was assumed for non-agricultural uses, including Christmas trees (Christmas tree plantations), developed (ornamentals (residential/commercial landscapes), field Nurseries (ornamentals/field nurseries), open space developed (ornamental turf grass, including golf courses and athletic fields and livestock pens).

3.3.2 Methodology and Recommendations for Improvement

The PCT calculations for thiamethoxam were a critical component to Step 2 of the effects determinations. The methods used and the assumptions made when estimating the PCT have a significant impact on the overlap percentages calculated and used in making both an NLAA/LAA decision as well as categorizing the confidence of determinations in the weight of evidence analysis. Here we present reviews of the analysis methods and their potential impacts on the outcome of the assessment.

3.3.2.1 The Acreage Used in Calculating Treated Acres Does Not Account for Acres Treated More Than Once a Year, Resulting in Overly Conservative PCT Estimates for Crops with potentially multiple applications

Section 2.1 of Appendix 1-7 of the draft Thiamethoxam BE states, "*One conservative assumption of this approach is that it [*PCT approach*] does not account for multiple applications to the same fields. Usage data represents the potential acres where at least one thiamethoxam application occurred. The data do not identify sites where multiple applications occur within the same year. The approach used here assumes that all treated acres are independent. Therefore, if the available usage data represent sites where multiple applications occurred (which is permitted on thiamethoxam labels), each acre is only counted one time. The aggregated UDLs will, however, overestimate the treated acres in a given year due to the conservative nature of the aggregation, especially when the total area in the UDL exceeds what is reported in the Census of Agriculture.*". For example, thiamethoxam labels allow two applications for cotton, soybean, potato and root and tuber vegetables, and three applications to tropical fruits, bushberry, and low growing berries (Appendix 1-2 of draft BE). Thus, not considering multiple applications in the PCT estimation, overestimates the acres treated and the associated PCT. This could have a great impact due to approximately 67% of the total acres treated are cotton and soybeans that allow multiple applications of thiamethoxam. Thus, it is critical that the PCT estimation account for the possible multiple applications, and the extent of actual treated acres and PCT estimation needs to be revised accordingly.

Recommendation: A methodology for deriving PCT values needs to be established which accounts for multiple applications on the same area of land. The methodology also must be consistent with annual application rates assumed in the exposure modeling, as the effects analysis considers both exposure likelihood and exposure magnitude concurrently. For some UDLs, information from AgroTrak or California PUR could be used to assess actual annual application rates and account for multiple applications to refine PCTs and address these issues.

3.3.2.2 PCT for Poultry litter UDL, the Methodology for Creating Aggregated UDLs of crops assumed for Poultry Litter Application, Combined with the Threshold 2.5% PCT Selected, Results in an Over-Prediction of Treated Acres and Usage

The draft BE for thiamethoxam indicates the availability of the SUUM usage of <500 pounds of thiamethoxam per year to poultry litter in the entire US. The agency assumes a threshold 2.5% PCT due to lack of data related to the average annual acres treated by poultry litter. While 2.5% PCT may seem small, given the broad extent of the poultry litter UDLs, there is a significant overestimation of treated areas, thus leading to unrealistic effects determinations. With the uncertainties involved with this poultry UDL, many acknowledged by the Agency itself, the analysis method fails to ground truth the resultant acres covered by poultry litter UDL. From our estimate of 680 million acres of poultry litter UDL (**Section 3.2.2.3**), application of default 2.5% PCT would result in a 17 million of acres of farmland to have applied treated poultry litter. This is far more than the total ~ 3 million acres of agricultural crops treated by foliar and/or soil applications and more than the total 4.671 million acres of farmland estimated to be available for poultry litter application by Kellog et al. (2000). These large overestimates of treated poultry litter in the UDL led to LAA determinations for 512 species in CONUS alone (EPA, 2021; Chapter 4, Table 4-8 of draft BE).

Recommendation: Based on the methodology prescribed in Appendix 1-7 of draft BE, when data on base and/or treated acres is unavailable in the survey information, estimates of treated areas could be calculated based on the average annual pounds active ingredient (a.i.) applied, minimum label rate and maximum label rate found in the SUUM (Equation 3-1, 3-2, 3-3 of Appendix 1-7). For example, the maximum estimated treated acres are calculated by dividing the average reported annual pounds a.i. applied by the minimum labeled application rate. After calculating the estimated maximum, average and minimum treated acres, the associated PCTs can be estimated by dividing the treated acres by total treatable acres reported in the SUUM when available, or the estimated treatable acres based on the area found in the UDL if the total treatable acres are not reported in the SUUM (shown in Equation 4 of Appendix 1-7).

$$Treated\ Acres\ (min) = \frac{annua\ pounds\ AI\ applied\ (avg)}{Label\ Rate\ (min)} \qquad \text{Eq. 3-1}$$

$$Treated\ Acres\ (avg) = \frac{annual\ pounds\ AI\ applied\ (avg)}{(\frac{\text{label rate (min)+label rate (max)}}{2})} \qquad \text{Eq. 3-2}$$

$$Treated\ Acres\ (min) = \frac{annual\ pounds\ AI\ applied\ (avg)}{Label\ Rate\ (max)} \qquad \text{Eq. 3-3}$$

$$PCT = \frac{Treated\ acres}{Total\ Treatable\ Acres} \qquad \text{Eq. 4}$$

We followed the EPA methodology to re-calculate PCT applicable for poultry litter UDL. Thiamethoxam usage data of ~ 500 average pounds usage annually provided in **Table 3.3.1** (also see draft BE Table 3 of Appendix 1-4) were used. Since the rate of application is not explicitly available for poultry litter application, rates of 0.266 and 0.007 lbs./acre for high and low application rates, respectively, that were assumed for exposure modeling were used to bracket the potential rates. Equations of 3-1, 3-2, 3-3 of Appendix 1-7 were used to estimate the maximum, average, and minimum acres treated. Then, Equation-4 was then used to estimate PCT for poultry litter UDL, i.e., by dividing the treated acres to the total treatable acres (680 million acres from poultry litter UDL).

Using the above equations, the estimated maximum, average, and minimum acres treated were 71,429, 3,663, and 1,880 acres, and the associated calculated PCTs were 0.011%, 0.0005%, and 0.0003%, respectively. Therefore, at the minimum, we recommend use of a 0.011% PCT (the max PCT) for the poultry litter UDL which takes into consideration the available usage information in lieu of the 2.5% PCT used by EPA.

3.3.2.3 Assumption of 100% PCT for Non-Agricultural Uses Resulted in Unrealistically Large Treated Areas.

EPA assumed 100% PCT for non-agricultural UDLs, including for turf UDLs applied to 'developed and open space developed UDLs' and field nurseries. The use of 100% PCT for turf applied to 'developed and open space developed UDLs' and field nurseries results in very high estimated treated acreage. These highly overestimated treated acreage led to 803, 735, 563 number of times the use sites of open space developed UDL, developed UDL, and nurseries UDL, respectively, predicted to impact species LAA determination, in CONUS alone (EPA, 2021; Chapter 4, Table 4-8 of draft BE).

We demonstrate the impact of using 100% PCT for turf UDLs (applied to developed and open space developed UDLs) to estimated treated acres and estimated amounts of thiamethoxam for turf uses, as example (**Table 3.3.2**). With the 100% PCT and label rate of 0.266 lbs./ac and 100% of the UDL acres treated, the estimated amount of thiamethoxam used on turf on developed and open space developed UDLs ranged 12 – 15 million pounds. This cannot be a realistic assumption based on the available information that agricultural usage accounts for about 185,000 pounds per year and non-agricultural uses are significantly lower than agricultural uses.

Below, we show realistic high-end PCT estimations for turf UDLs. By taking a hypothetically worst-case scenario and assuming usages on turf to both developed and open space developed UDLs to be equivalent to the total usages reported for agricultural uses (185,000 pounds). We estimated the worst-case treated acres to be 377,744 acres for each turf UDL based on 185,000 pounds usage for both developed and open space developed UDLs and label application rate of 0.266 lbs./ac. Further, we estimated a PCT by incorporating these worst-case treated acres divided by UDL acreage. Our calculations shows that a realistic PCT to each turf UDL should not exceed the 0.6 - 0.7% PCT (**Table 3.3.2**) calculated from hypothetically worst-case scenario.

Table 3.3.2 Comparison of Estimated pounds from turf using 100% PCTs assumption to the total usage data from agricultural crops, and alternative PCT calculations for turf uses on developed and open space UDLs

Turf UDLs	***CONUS UDL Acreage,***	**PCT (%) BE**	**Treated Acres[1]**	**Estimated Pounds[2]**	**Treated Acres[3]**	**Max PCT (%)[4]**
		BE			Syngenta	
Developed	48,458,739	100	48,458,739	12,890,025	377,744	0.7%
Open Space Developed	57,185,347	100	57,185,347	15,211,302	377,744	0.6%

1. treated acres for developed and open space developed were based on EPA's BE 100% PCT assumption and acreage covered from each UDL
2. estimated pounds for both developed and open space developed were calculated based on total treated acres (with the assumed 100% PCT) and multiplied by the max label rate (0.266 lbs./ac) found in Appendix 1-2 of draft BE
3. Syngenta calculated worst-case scenario treated acres based on the total usage of 95,000 pounds for each of the two turf use UDLs (185,000 pounds usage agricultural crops in Appendix 1-7 of draft BE divided by 2) and dividing it by the max label rate (0.266 lbs./ac) found in Appendix 1-2 of draft BE
4. Max PCT calculated by Syngenta = worst-case scenario treated acres divided by UDL acreage

Recommendation: The PCTs used for non-agricultural uses of thiamethoxam need to be revised and results of overlap analysis need to be adjusted by the revised PCT's. Our calculations show that the PCT estimate/assumption to both developed and open space developed UDLs should not exceed the 0.6 - 0.7% PCT calculated from hypothetically worst-case scenario.

3.3.2.4 Contribution of Drift from Non-agricultural Uses to impacts is overestimated

Contribution of drift to an individual species is estimated from a drift area from a potential use site. When usage data are considered, the extent of areas receiving spray drift is decreased to account for the actual treated area portion of the total cropped acres in the UDL. For all non-agricultural uses, since no usage information is considered, the drift extent originally calculated based on all potential use sites remained unrefined. As shown from the draft Thiamethoxam BE result summary table, Appendix 1-4, non-agricultural uses, including turf uses (to developed, open space developed) and field nurseries have the highest percent of drift contribution to impact.

Recommendation: The contribution of drift from non-agricultural uses need to be revised following changes to the PCT that is appropriate to non-agricultural uses (see PCT recommendations presented in **Section 3.3.2.4**).

3.3.2.5 Agricultural PCTs and Non-agricultural PCTs, the "Maximum/Upper" Usage Scenario is Overly Conservative When Allocating all State Treated Acres to Occur within Every Species Range/Critical Habitat

The maximum/upper usage scenario is the most conservative usage scenario, using the maximum PCT treated acres and assuming all usage in a state occurs within a species range. When the geographic regions representing species ranges/critical habitat are independent (i.e., no overlap), the outcome when looking across multiple species can be treated areas that vastly exceed the predetermined PCT and treated areas for each UDL at the state level. This is because the treated acres for an entire state get focused over different geographic locations associated with multiple species ranges. Given the importance that the "maximum/upper" scenario has in Step 2 of the effects determinations, the impacts of this overly conservatism may be substantial.

Recommendation: The assumption of all usage within a species range combined with the maximum PCT as an overly conservative usage should be revised. The potential impacts of the same maximum treated acres for a UDL within a state getting moved around the state to always fall within different species ranges is unrealistic, especially the weight given to the most conservative usage scenario throughout Step 2 of the draft Thiamethoxam BE. An appropriately conservative alternative would be to use a "maximum/uniform" scenario instead of the "maximum/upper" scenarios.

3.4 Evaluation of Impacts of Species Data, Use Sites and PCT on the Outcome of BE LAA determinations

In this section, impacts of species data, use sites and PCT on the Outcome of draft Thiamethoxam BE LAA determinations are provided by taking a few select species as examples and the effects determination result provided in the draft BE. These examples demonstrate the impacts of the various aspects of previously stated reviews, including lack of considerations of species-specific habitat requirements, use of a methodology and assumption used in creating use sites UDLs resulting in an over-prediction of potential use sites, and overly conservative PCT estimates.

3.4.1 Ash Meadows blazings (Sp.ID = 776) and Ash Meadows gumplant (Sp.ID = 941)

Below are examples of BE outcomes when the unrealistic poultry litter UDL and its overly conservative PCT estimates were used. Draft BE results for thiamethoxam (Chapter 4 of draft BE; EPA, 2021) for the ranges of Ash Meadows blazings (Sp.ID = 776) and Ash Meadows gumplant (Sp.ID = 941). These two species share the same geographical areas, of which 99% resides in federal land and are reported likely to be adversely affected (LAA) from the use of thiamethoxam. The LAA determination was based on one use only and based on indirect effects only. It was also indicated that the LAA determination was based on only Poultry Litter UDL use, and direct overlap with use site was determined to be 19.43% (Max_Upper = Maximum PCT, upper distribution of acres within species range)

Noted Inconsistencies:

Our overlap analysis of the range map with all uses UDLs resulted in < 1% direct overlap. Our overlap analysis was done from UDLs representing various thiamethoxam use sites aggregated from 2014-2019 CDL. For visual demonstration, we also used USDA/NASS's CropScape, a web-based interactive map visualization for cropland, to show the location of range map with respect to any crops/pastures (**Figure 3.4.1**). As shown in the map of **Figure 3.4.1,** there aren't any crops within the range and there may be only a few sparse pixels classified as pasture within and outside the range. However, we couldn't envision any scenario where the percent of overlap could reach to a level of 19.43% overlap (Max_upper, after PCT application) indicated in the draft BE.

Figure 3.4.1 Location of range map for "ash meadows blazings" and "ash meadows gumplant" with respect to locations of crops/pastures

Different colors in the map represent crops/pastures using crop mask layer of 2016-2020 Crop Data Layer from CropScape (https://nassgeodata.gmu.edu/CropScape/)

In addition, the range maps of these species have been changed and updated by FWS since November 2020, EPA's data downloaded period (**Section 3.1.2.1**, **Table B- of Appendix 1**).

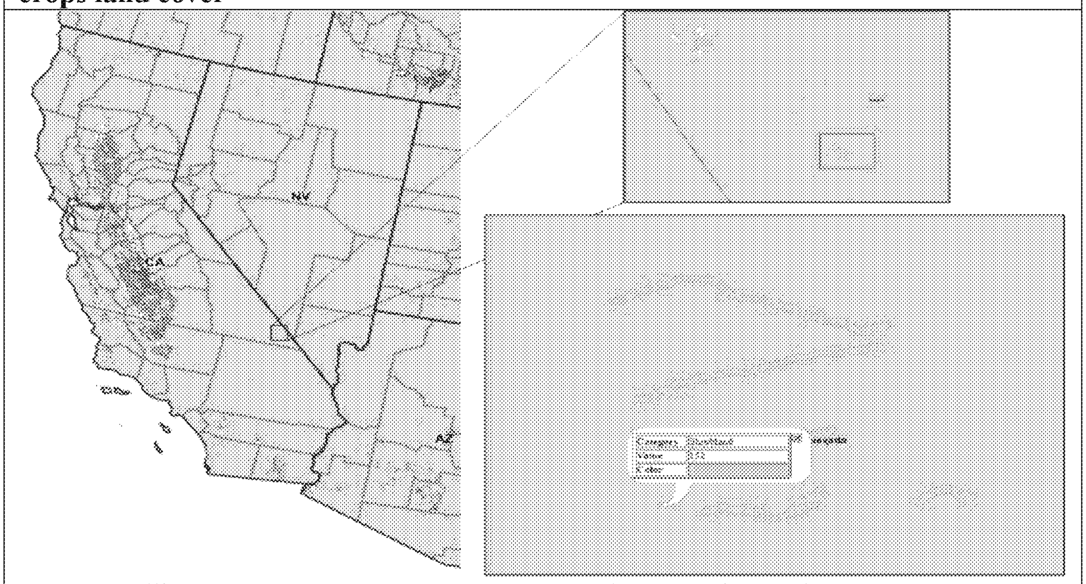
Recommendation: We recommend EPA perform the analysis using the updated range map for both species. In addition, since the LAA determination was based only on poultry litter use UDL, and since there isn't any crop land within this range (99% of its area under federal land) that is potentially available for poultry litter application, the overlap analysis should be redone using a revised poultry litter use UDL that doesn't include pastureland CDL, and its associated PCT. See **Sections 3.2.2.2 and 3.3.2.2** for recommendation provided to revise poultry litter use UDL and its associated PCT.

3.4.2 Warm Springs pupfish (Sp.ID = 231)

Below is another example of BE outcome when unrealistic poultry litter UDL and its overly conservative PCT estimates were used. Warm Springs pupfish, a listed fish species that resides 100% of its area in federal land, are reported in the draft BE likely to be adversely affected (LAA) from the use of thiamethoxam. The LAA determination was based on only one use. It was also indicated that the LAA determination was based on only the Poultry Litter UDL use, and direct overlap with use site was determined to be 13.26% (Max_Upper = Maximum PCT, upper distribution of acres within species range)

Our overlap analysis of the range map with all uses UDLs (generated using 2014-2019 CDL) resulted in < 1% of direct overlap, including poultry litter UDL that doesn't include pasture CDL. We noted the land cover within the species range are dominated by shrubland and wetland areas. For visual demonstration, we also used USDA/NASS's CropScape, a web-based interactive map visualization for cropland, to show the location of range map with respect to any crops/pastures (**Figure 3.4.2**). As shown in the map of **Figure 3.4.2**, there aren't any crops within the range, but there could be seen only a few sparse pixels classified as pasture within and outside the range. However, we couldn't envision any scenario where the percent of overlap could reach to a level of 13.26% (Max_upper, after PCT application) indicated in the draft BE. If a revised poultry litter use UDL that doesn't include pasture land CDL were used, the percent overlap would have been < 1%, , and this species could potentially be a NLAA determination.

Figure 3.4.2 Location of range map for "Warm Springs pupfish" showing lack of crops land cover



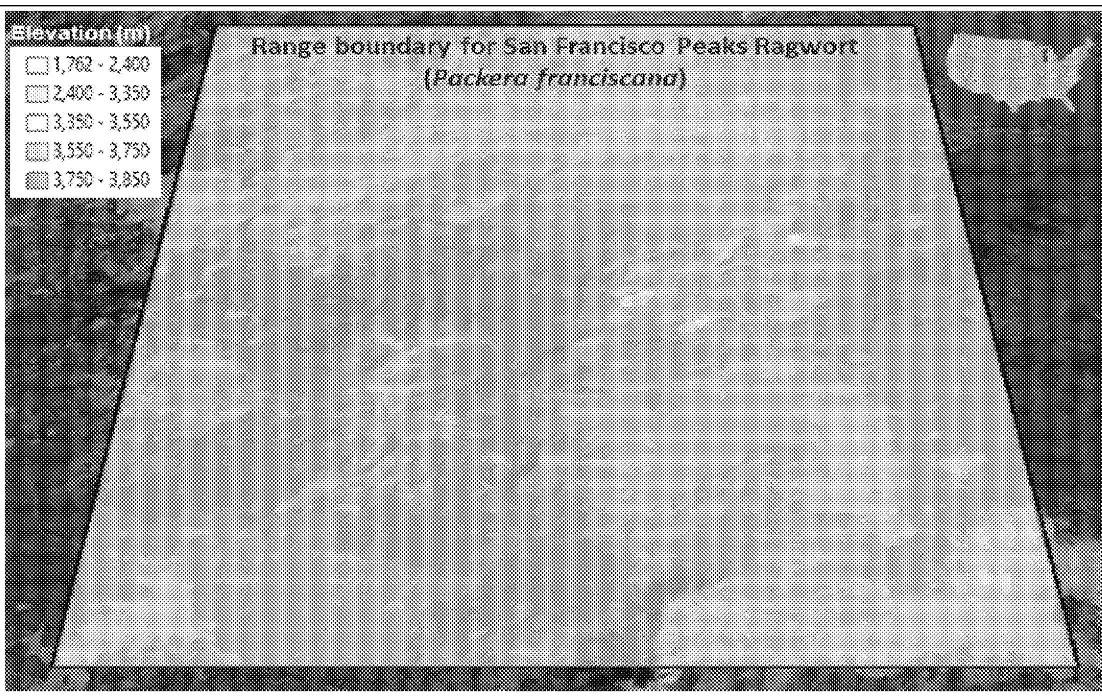
Different colors in the map represent crops/pastures using crop mask layer of 2016-2020 Crop Data Layer from CropScape [https://nassgeodata.gmu.edu/CropScape])

Recommendation: We recommend EPA perform the analysis using a revised poultry litter use UDL that doesn't include pastureland CDL, and its associated PCT. See **Sections 3.2.2.2 and 3.3.2.2** for recommendation provided to revise poultry litter use UDL and its associated PCT.

3.4.3 San Francisco Peaks Ragwort (Sp.ID = 827)

Below is an example of a BE outcome when available species attribute data are not utilized completely. While the revised method and subsequent BEs mentioned the use of species attributes to better inform where within a range and how many individuals may be exposed to a given pesticide, the accuracy and evaluation process identified for these data were not applied consistently or completely. Additionally, these data were not applied early enough in the process to be informative. For example, EPA identified a Francisco Peaks Ragwort (*Packera franciscana*), a threatened plant that grows in alpine fellfields, that have an elevation restriction of above 3,350 - 3,750 meters (10,990 - 12303 feet) in the draft Thiamethoxam BE (EPA, 2021) indicating a habitat requirement or other life history process that is tied to a specific elevation. If a species is restricted to a certain elevation, the possibility of it occurring outside of this elevation is very small. The range file should be refined so that it only includes the elevations used by the species (see yellow and reddish color with the species range in the map shown in **Figure 3.4.3**).

Figure 3.4.3 Location of range map for "San Francisco Peaks Ragwort" and elevation map that could help refine the range map



For this species, the current range used by EPA covered 151,706, acres. EPA determined that the plant was likely to be adversely affected from the use of thiamethoxam without considering the limited distribution of the species due to elevation. If the elevation data were used, it would be clear that this species exists far from any agricultural use sites, and this species could be a No Effect or a NLAA determination.

Recommendation: For species with elevation restrictions, more specific maps should be available and/or should be generated using information related to suitable habitat consideration. Considering where the species is limited due to habitat factors better informs where the species is in relation to use sites where a pesticide may be applied. Once refined, ranges should be used as the primary input data source representing species ranges prior to Step 1 in a revised method.

3.4.4 Impacts of Insufficient Use site representations, PCT and Associated Treated Area Analysis to BE Outcomes

Table 4-8 of Chapter 4 in the draft BE lists the number of times a UDL in CONUS was predicted to impact a species based on draft LAA determinations, and the ranks of all assessed UDLs relative to each other. This summary table is also presented below in **Table 3.3.4**. The comments provided below focus on the assessment results in this table, i.e., CONUS; however, most comments are also applicable for assessment results outside the CONUS.

The three non-agricultural UDLs representing developed turf uses, "open space developed" and developed, and field nurseries were found to be the three UDLs with the highest number of species impacted, at 803, 735 and 563 respectively (**Table 3.3.4**). Even though there was no quantitative non-agricultural usage data, the non-agricultural uses were far less than agricultural usages accounted in the SUUM. Despite their lower usages, however, the analysis determined that the non-agricultural uses have the greatest impacts to the largest number of species LAA determinations.

Table 3.4.4 Summary of Impacts of Thiamethoxam UDLs on LAA Effects Determinations presented in Draft BE Chapter 4: Table 4-8

UDL	Number of times UDL predicted to impact a species	Rank
CONUS_Open Space Developed	803	1
CONUS_Developed	735	2
CONUS_Field Nurseries	563	3
CONUS_Poultry Litter	512	4
CONUS_Vegetables and ground fruit	417	5
CONUS_Other Crops	404	6
CONUS_Other Orchards	391	7
CONUS_Other Grains	300	8
CONUS_Grapes	218	9
CONUS_Cotton	195	10
CONUS_Soybeans	171	11
CONUS_Citrus	151	12
CONUS_Other Row Crops	103	13
CONUS_Xmas Trees	72	14
CONUS_Thia Other Row Crops ORWA	8	15

The next highest and fourth ranked UDL is the "Poultry Litter" UDL (generated to represent thiamethoxam uses on poultry litter) with 512 draft LAA determinations. Based on the SUUM, the annual total thiamethoxam usage in poultry litter was <500 pounds (see **Table 3.3.1**) relative to total 185,000 pounds applied annually to agricultural crops by foliar and soil applications. In comparison, "cotton" and "soybean" UDLs, the two agricultural UDLs with high usages, were ranked number 10 and 11, with 195 and 171, respectively, species LAA determinations. It is hard to reconcile that poultry litter with usage of 0.27% (500 lbs./185,000 lbs.) of the total agricultural usage would have almost 3 times the number of species with LAA determinations compared higher usage scenarios, e.g., cotton and soybean crops. This shows how critical it is for usage data to be properly accounted for in the species LAA determination, and most importantly how the LAA determinations were seriously influenced by the potential use site representations (**Table 3.3.5**)

Table 3.4.5 Summary of Uncertainties/issues associated with Select Thiamethoxam UDLs

CONUS UDL	**Uncertainties/Issues**
Open Space Developed	• Use of 100% PCT combined with uncertainties with NLCD class 21 to represent turf potential use sites to this UDL • Drift contribution due to this UDL is overestimated, and wasn't adjusted to usage due to 100% PCT assumptions • (for details see **Sections 3.3.2.3 and 3.3.2.4**)
Developed	• Use of 100% PCT combined with uncertainties with NLCD classes 22-24 to represent turf potential use sites • Drift contribution due to this UDL is overestimated, and wasn't adjusted to usage due to 100% PCT assumptions • (for details see **Sections 3.3.2.3 and 3.3.2.4**)
Field Nurseries	• Use of 100% PCT combined with uncertainties with multi-UDL grouped to represent potential use sites to this UDL • Drift contributions due to this UDL is overestimated, and wasn't adjusted to usage due to 100% PCT assumptions • (for details see **Sections 3.3.2.3 and 3.3.2.4**)
Poultry Litter	• Flawed and excessively erroneous representation of potential use sites • PCT selected for this UDL is too high and resulted in excessively overpredicting treated area • (for details see **Sections 3.2.2.3 and 3.3.2.2**)
Vegetables and ground fruit	• The multi-crop UDL represents non-labeled uses sites this has impacts on Step 1 of ESA process; in Step -2, though a 0% PCT was used to correct for the non-labeled use sites, it may not be able to correct when the non-labeled crops are the majority of the crops that overlap the species range or critical habit. • (for details see **Section 3.2.2.5**)
Other Crops	• We believe this UDL is include by error, unless EPA has justifications for its inclusion • (for details see **Section 3.2.2.4**)

Table 3.4.5 Summary of Uncertainties/issues associated with Select Thiamethoxam UDLs	
CONUS UDL	**Uncertainties/Issues**
Other Orchards	• The multi-crop UDL represents non-labeled uses sites this has impacts on Step 1 of ESA process; in Step -2, though a 0% PCT was used to correct for the non-labeled use sites, it may not be able to correct when the non-labeled crops are the majority of the crops that overlap the species range or critical habit. • (for details see **Section 3.2.2.5**)
Other Grains	

Table 3.3.5 summarizes select UDLs that have the highest impacts and the weaknesses associated with their potential use site representations and 100% PCT assumptions and/or conservative PCT. The three non-agricultural UDLs representing developed turf uses, "open space developed" and developed, and field nurseries with the highest number of species being impacted, assumed 100% PCT in combination to their use site representations using crude imagery data layers with unknown accuracies. The poultry litter UDL with fourth highest impact was evaluated to have a use site representation with grossly overestimated geographic coverage and an associated PCT that overly overestimate treated areas and usages. The potential use site representation and wrong PCT assumptions used in the BE contributed to overstating LAA determinations.

In addition, the vegetables and ground fruit UDL was ranked 5th highest (1st from agricultural uses) with 417 species LAA determination. As previously discussed, this UDL has high uncertainty in its potential use site representation, because one of the crops represented with multi-crop UDL included non-labeled uses sites (**Section 3.2.2.5**). Even though, attempts were made to use a 0%PCT for non-labeled uses, this may not correct for many species if the non-labeled crop happens to be the majority of the crops that overlap the species range or critical habit. The next highest reported agricultural crop was the "other crops" UDL with 404 draft LAA determinations. Even though there could be much to say about the "other crops" UDL, this being one of the multi-crop UDLs and the almost 100% PCT assumption (for most states due to lack of usage data), this UDL should not be part of the Thiamethoxam BE. We believe this UDL was included inaccurately in the analysis as there were no matching registered crop uses for thiamethoxam in this UDL group.

The above synopsis of results points to the implications of the significant inadequacies in the representations of potential use sites, 100% PCT assumptions for non-agricultural uses, and the methods used to estimate PCTs for agricultural crops. This subsequently contributed to unrealistic percent overlap between treated use sites and species ranges that were eventually used in the effects determinations. The implications were clear from the results that uses that represent far less usage in magnitude were found to have the greatest impact to the listed species across CONUS. Thus, the draft BE needs significant revisions to the potential use site representations and PCT/treated areas analysis in order to provide realistic outcomes of the effects determinations.

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4 Tools Used in the Biological Evaluation

4.1 MAGtool

In the draft Thiamethoxam BE, the Agency indicated that the MAGtool v2.3.1 was applied. There are difficulties in making the MAGtool a user friendly, transparent, efficient, and scientifically consistent tool for use in BE development. Some of the technical/mechanistic issues related to the draft Thiamethoxam BE are described below. A more comprehensive critique of the MAGtool as it relates to all three neonicotinoid draft BEs can be found in Appendix 1.0.

EPA did not appear to use the same input parameters that they provided in the draft Thiamethoxam BE. For instance, for the 40 bird species evaluated in the draft BE, Syngenta's MAGtool run showed differences in outputs for the adjusted dose-based sublethal endpoint values for all the bird species[1]. The calculations for the adjusted dose based sublethal endpoints are determined in cell T36 of the "TerrRESULTS" worksheet in the "MAG TerrTool v2.3.1" workbook and rely on input parameters for the species body weight, the "MATC or LOAEC" parameter and the weight of the tested animal. These inputs are found within the MAG TerrTool v2.3.1 workbook in the "Min rate doses" worksheet for the species body weight and the "MAGtool inputs" worksheet for the "MATC or LOAEC" parameter and the weight of the tested animal. The reason the adjusted dose based sublethal endpoints are different in the draft thiamethoxam BE is because EPA used 28 g as the weight of the tested animals instead of the 25 g which they provided to the public as the input endpoint. There is no discussion in Chapter 2 of the Thiamethoxam BE why the 25 g was selected as the weight of the test animal. Confirmatory calculations of the Excel equations provided in cell T36 of the "TerrRESULTS" worksheet show that once the body weight of the test animal is changed to 28 g then the replicate results become identical to those provided in the draft Thiamethoxam BE for the 40 bird species (data not shown). Moreover, the use of the 28 g as the input parameter also addresses the inconsistency observed in birds for the adjusted dietary direct threshold value. The calculations where the bird dietary thresholds are modified takes place in cell T35 of the "TerrRESULTS" worksheet in the MAG TerrTool v2.3.1 workbook and also relies on the "Weight of the test animal" as an input parameter for birds. Changing the weight of the test animal from 25 g (i.e., value provided by EPA) to 28 g also resolved the inconsistencies observed in the replicate analysis for the adjusted dietary direct threshold value (data not shown). Therefore, EPA did not provide the same input parameters that they used in their assessment.

Recommendation: Clarify and provide justification for the body weight adjustment that supports the results.

Other inconsistencies noted by the replicate analysis of the bird species in the Thiamethoxam BE include selection of different values by the MAGtool workbooks. The MAG TerrTool v2.3.1 workbook selected different values in the "Animal multi species" worksheet for several parameters. These differences including the selection of a different value for the "Type of endpoint" in Step 1 (e.g., draft BE selected "Indirect mortality dietary" but the replicate analysis selected "Indirect sublethal dietary"), selection of the different taxa for Step 2 (e.g., the draft BE selected "Invertebrate diet" but the replicate analysis selected "Arthropods (above ground)"), selection of a different endpoint for the "EEC/endpoint" in Step 2 (e.g., draft BE selected "Aquatic" while the replicate selected "Dietary"), selection of the different value for the most sensitive indirect endpoints in Step 1 and Step 2 (e.g., the draft BE selected 0.007 and 0.05 values, respectively while the replicate analysis selected 0.0014 for both Step 1 and Step 2 analysis), selection of the different "TGAI (Aq only)" endpoint (e.g., draft BE selected 0.05 value while the replicate analysis selected "NA"), selection of the different endpoint type based on indirect sublethal effects (e.g., the draft BE selected the endpoint value of 6900 but the replicate analysis selected 0.32 for the same parameter), the selection of different values for the "Indirect (dose or dietary); dietary only; animals - mort only" parameters (e.g., the draft BE selected the value of 6900 but the replicate analysis selected a value of 0.32 for the same parameter), the presence of values for 13 use layers from the indirect alternative analysis (i.e., the draft BE did not have values based on indirect effects but the replicate analysis did), the differences in drift impacts from indirect applications (e.g., the draft BE did not have

[1] The replicate analysis noted differences in all the adjusted dose-based sublethal endpoint values (i.e., presented as "LOAEL or MATC (mg/kg-bw)" in Appendix 4-9 of the draft thiamethoxam BE and located in column AZ of the "MAX Upper CB" worksheet in the "Thiamethoxam Range Terrestrial Animal Birds All" workbook)

drift impact but the replicate analysis did) and the differences in the minimum and maximum total number of individuals impacted from the alternative analysis for indirect effects (e.g., the draft BE did not have values but the replicate analysis did). Examination of the Excel code for the inconsistent parameters indicated that the values displayed in the replicate analysis were referencing the correct cells in the worksheets provided within the MAG TerrTool v2.3.1. workbook. However, since EPA did not use the same values, they provided the general public (e.g., as discussed above the use of 28 g instead of the 25 g as the weight of the tested animals for birds), it is entirely possible that other values were also not provided for public review. It is impossible to understand the difference observed in our replicate analysis without having access to the same MAGtool workbooks EPA used to derive their results. It is critical that EPA provide the original MAGtool workbooks (e.g., MAG TerrTool, MAG AquaTool etc.) used in their analysis for the public to be able to verify that the same input parameters were used and be able to explain inconsistencies observed in the replicate analysis.

Similarly, we request that EPA needs to provide the CB output template workbooks for each taxon they analyze to be more transparent and ensure accuracy in the comments submitted. The CB output template workbook incorporates the results from the MAG TerrTool or MAG AquaTool and contains Excel code that calculates the effects determination and the strength of call for each species. The CB output template workbook performs calculations for each species (i.e., one species at a time) and exports the finalized results (i.e., species summaries) to the effects determination workbook where all the species that moved on to Step 2 analyses are presented as the final output from the MAGtool analysis. EPA provides the public with the finalized effects determination workbook (i.e., the WoE outputs in Appendix 4-9) but does not provide the CB output template workbook which shows how the determinations were derived. Several inconsistencies have been observed in our replicate analysis that cannot be explained without having access to the same template workbook EPA used during their analysis.

Recommendation: It is critical that EPA provide the original MAGtool workbooks (e.g., MAG TerrTool, MAG AquaTool etc.) and the CB output template workbook from each analysis for the public to be able to understand how EPA chose their values and derived their conclusions.

To assess the sensitivity and conservativeness of the MAGtool, several runs were performed using two terrestrial plant and two terrestrial invertebrate species to understand what alterations were required to change the species call from an LAA to an NLAA or NE determination. The deterministic analysis was selected in the MAGtool Batch analysis tool for species range using two plants (e.g., the monocot Thread-leaved brodiaea (*Brodiaea filifolia*; Entity ID 416) and the dicot San Diego thornmint (*Acanthomintha ilicifolia*; Entity ID 496)), and two terrestrial invertebrates (e.g., the Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*; Entity ID 436) and the American burying beetle (*Nicrophorus americanus*; Entity ID 440).

In brief, the effect thresholds for the four organisms were modified in the "Toxicity inputs" worksheet located in the "WoE Input parameters" workbook for each neonic and subsequently loaded into the MAG TerrTool v2.3.1. The effect thresholds in the "Toxicity inputs" worksheets were multiplied by a factor of 1,000, 10,000, 100,000, 1,000,000 and 10,000,000 until the species investigated changed from an LAA to NLAA or NE determination.

To change the LAA species call to an NLAA or NE determination for these organisms the following changes were performed to the "Toxicity inputs" worksheet:

- The threshold effect values for terrestrial plants and invertebrates were multiplied by a factor of 100,000. The multiplied toxicity endpoints are far above the rates that would occur on treated areas, let alone off-field areas.
- Aside from the slopes, the duration of the study days and the weight of the animal every parameter in the toxicity input worksheet was multiplied by a factor of 100,000 for plants to address indirect effect (PPHD calculations). Similarly, every parameter, apart from the slopes, duration of the study and the weight of the animals, in the toxicity inputs worksheet for terrestrial invertebrates was multiplied by a factor of 100,000.
- Although lower multipliers were used initially (i.e., 1,000x, and 10,000x), it became clear that significantly more orders of magnitude were required to begin to see a change from LAA to NLAA or NE for these organisms.

Table 4.1-1 shows the highest multiplication factor required to change the species call from LAA to NLAA or NE for the plants and terrestrial invertebrates species investigated. The highest multiplication factor applied to terrestrial plants to change to NE determination was 100,000x. However, since the LAA determination still occurred at 10,000x for both plant species it is likely that the multiplication factor required to change to NE determination occurs between 10,000x and 100,000x. Similarly, since the highest multiplication factor required to change the species call to NLAA or NE for terrestrial invertebrates is 100,000x it is likely that the multiplication factor required to change from the LAA determination occurs when the toxicity parameters are multiplied between 10,000 and 100,000x.

This assessment was not a definitive quantitative analysis of the conservatism of the MAGtool. It is very clear that EPA's application of the Revised Method using the MAGtool results in an extremely conservative, and unrealistic assessments of risk. Compounding conservatism is an issue with this tool, and as such it is extremely difficult once a May Affect determination is made, to arrive at anything but an LAA determination unless the species is deemed to be extinct or extirpated, found in the ocean where exposure is negligible and where effects through PPHD are not anticipated, the species is a karst organism or, on occasion, species with a common traits (e.g., beach habitat) may be considered unlikely to be exposed (Steps 2a-e).

Table 4.1-1. The highest multiplication factor applied to benchmark parameters in the MAGtool toxicity inputs worksheet to change the species call from LAA to NLAA or NE

Plants:	
Thread-leaved brodiaea Entity ID 416	x100,000[a]
San Diego thornmint Entity ID 496	x100,000[a]
Terrestrial Invertebrates:	
Valley elderberry longhorn beetle Entity ID 436	x100,000[b]
American burying beetle Entity ID 440	x100,000[a]

[a] No Effect (NE) determination

[b] Not Likely to Adversely Affect (NLAA) determination

LAA – Likely to Adversely Affect

NLAA – Not Likely to Adversely Affect

x – Multiplication factor

Recommendation: MAGtool model conservatism should be quantitatively evaluated in a Science Advisory Panel (SAP) to ensure that the model is identifying listed species and or critical habitats where adverse effects are 'reasonably certain to occur' and identified using the best available data. Without this effort, the evaluation burden is being shifted to the Services as most listed species and critical habitats that enter the BE process will continue to require consultation whether they may be at potential risk, or not. Thus, the efficiency, transparency and the scientific robustness of the entire process will continue to be questioned.

4.2 Plant Assessment Tool (PAT)

The Plant Assessment Tool (PAT) is used to estimate exposures to plants in terrestrial habitats in the draft Thiamethoxam BE. Thus, the PAT results were a critical component in the analysis plans and had a significant impact in making NLAA/LAA decisions. A critique of the terrestrial plant exposure zone conceptual model, the wetland plant exposure zone conceptual model and their potential impacts on the outcome of the effect determinations in the draft BE are listed below. A critique of the currently available code implementation of PAT is also provided. Additional information related to the PAT critique is available as part of a more comprehensive critique of all three neonicotinoid draft BEs in Appendix 1.0

The Terrestrial Module of PAT is a New Tool Designed to Refine Screening-Level Exposure Estimates and Has Not Been Thoroughly Reviewed: PAT uses its own set of algorithms to simulate pesticide transport and fate. The manual indicates that the algorithms are based on the equations used by PRZM. At a minimum, the PRZM algorithms were translated from Fortran to Python with some modifications to account for specifics of the T-PEZ conceptual model. Even if the fate and transport equations are well understood and sufficiently coded in Fortran, the modifications required for the T-PEZ conceptual model and for translating them to Python code are significant and prone to potential errors.

Recommendation: PAT and especially the terrestrial module should go through a Science Advisory Panel (SAP) review. In addition, the scientific community and all stakeholders should get the opportunity to review and test PAT before it is being used in Biological Evaluation supported by the EPA. Conference/workshop presentations are inadequate to validate the scientific integrity of a new model.

The T-PEZ Conceptual Model Assumes That All Runoff from the Field Enters the T-PEZ as Sheet Flow and Does Not Account for Many Site-Specific Factors Which Have an Impact on the Occurrence of Runoff into the T-PEZ: The terrestrial module assumes that the T-PEZ is always immediately adjacent to a treated field, which is exposed to pesticide via sheet flow and spray drift from the treated field. The PAT manual states on page 7 to 8: "An evaluation of available literature indicates that the distance sheet flow travels before becoming concentrated flow varies depending on roughness and slope of the landscape, with flow lengths ranging from 4 to 100 m but typically between 15 and 30 m." Based on the literature review, it is unreasonable to assume that all runoff from a field enters the T-PEZ as sheet flow. As acknowledged in the uncertainty section of the PAT manual, there are many different factors (e.g., slope, surface roughness, flow path length) influencing runoff into the T-PEZ. These factors may vary greatly between different application sites (e.g., row crops, vegetables, orchards, hay, pasture). PAT does not account for site specific characteristics and field management practices (e.g., terracing, contour farming, runoff and erosion controls, irrigation/drainage ditches, rills, and creeks) which may result in less opportunity for 100% sheet flow runoff into the T-PEZ.

Recommendation: The T-PEZ conceptual module should acknowledge that the fraction of sheet and channelized flow changes depending on site-specific characteristics. It is not appropriate to always assume that runoff from a field enters the T-PEZ as sheet flow and is maintained as sheet flow through the 30 m terrestrial vegetation community. The following changes to the T-PEZ conceptual model are needed: (1) The fraction of flow entering the T-PEZ as sheet flow needs to be an input parameter and (2) PRZM scenario specific sheet flow fractions need to be developed. This would lead to some fraction of "bypass" channelized flow moving past/through the T-PEZ.

The Manual has Contradictory Statements Regarding the Location of the T-PEZ Relative to a Treated Field and the Buffer / Setback PAT Input Parameter has No Impact on Runoff Loadings: The manual (Section 3.1) states: "This module is intended to represent a non-target terrestrial (non-inundated) plant community immediately adjacent to a treated field, which is exposed to pesticide via sheet flow and spray drift from the treated field." The same section contradictory states: "Exposure and risk to terrestrial dry-land vegetation beyond the 30-m T-PEZ boundary only consider spray drift foliar deposition (based upon AgDRIFT Tier I or custom deposition curves)." Based on the two statements cited above, it is not clear whether the T-PEZ is always assumed to be immediately adjacent to a field or if there can be a buffer between the treated field and the exposure zone. The module includes a 'buffer_setback' input parameter indicating that the latter is the case. This 'buffer_setback' parameter has an impact on drift loadings but is non-sensitive to the estimated runoff loadings. The PAT manual states on page 7 to 8: "An evaluation of available literature indicates that the distance sheet flow travels before becoming concentrated flow varies depending on roughness and slope of the landscape, with flow lengths ranging from 4 to 100 m but typically between 15 and 30 m."

Recommendation: The manual should be revised, and the contradictory statements removed and clarified. The 'buffer_setback' parameter should have an impact on the fraction of flow entering the T-PEZ as sheet flow. As the 'buffer_setback' increases the fraction of sheet flow entering the T-PEZ should decrease (a larger fraction of the runoff loadings would infiltrate before reaching the T-PEZ and another fraction would by-pass the T-PEZ as channelized flow without interacting with the terrestrial plants). At a minimum, the 'buffer_setback' parameter should acknowledge that there is no sheet flow beyond a 30 m travel distance to be consistent with the statements in the manual and the methods used in the neonicotinoid BEs.

The Water Balance and Run-Off / Infiltration Calculations Are Overly Simplistic: According to the manual, the daily T-PEZ water balance can be expressed as

$$R_i + P_i = I_i + Q_i + \theta_i V_{TPEZ} \qquad \text{(Equation 1)}$$

where i is the current day, R_i is the runoff from treated field (m^3), P_i is the precipitation onto the T-PEZ (m^3), $Q_i$is the runoff out of the T-PEZ (m3), I_i is the volume leaching below the root zone (m^3), and $\theta_i V_{TPEZ}$ is the available water capacity in the T-PEZ (m^3). In the last term θ represents the volumetric soil water content of the soil (m^3/m^3) and V_{TPEZ} is the volume of the T-PEZ (m^3). It should be noted that the description of V_{TPEZ} in the manual is wrong. It is not the volume of the T-PEZ (which would be the product of length (316.228 m), width (30 m), and depth (0.15 m)), instead it is the available water capacity holding potential ((field capacity - wilting point) * volume of the T-PEZ).
First, the incoming volume into the T-PEZ is calculated from PRZM output ($R_i + P_i$).
Next, the amount of water entering ($R_i + P_i$) plus the amount present from the previous day is compared to the field capacity to calculate the volumetric soil water content θ:

- if ($R_i + P_i$) is equal to zero, then θ_i is set to the wilting point,
- if $\frac{R_i+P_i}{V_{TPEZ}} + \theta_{i-1}$ is greater than or equal to field capacity, then θ_i is set to field capacity, and
- if $\frac{R_i+P_i}{V_{TPEZ}} + \theta_{i-1}$ is less than field capacity, then θ_i is set to $\frac{R_i+P_i}{V_{TPEZ}} + \theta_{i-1}$.

The equations above describe how θ_i is calculated. However, as mentioned above, there are inconsistencies between the manual and the code. While the manual uses the T-PEZ volume V_{TPEZ} as the denominator in the comparison terms, the code uses the available water volume ((field capacity - wilting point) V_{TPEZ}), which makes more sense.
Finally, the water leaving the T-PEZ (infiltration below the root zone and runoff) is calculated as:

$$I_i + Q_i = R_i + P_i - \theta_i V_{TPEZ} \qquad \text{(Equation 2)}$$

This equation stated in the PAT manual is wrong and should be:

$$I_i + Q_i = R_i + P_i - (\theta_i - \theta_{i-1}) V_{TPEZ} \qquad \text{(Equation 3)}$$

This very simplistic water balance approach is problematic because it assumes that the soil water content is set to the wilting point on all days without precipitation or incoming runoff from the adjacent field, no matter if the soil was at saturation on the previous day. This results in underestimation of the soil moisture in the first layer and thus leads to a significant underestimation of runoff leaving the T-PEZ. Because of this, plant exposure within the T-PEZ may be over-estimated. In addition, the amount of runoff leaving the T-PEZ is independent from the soil moisture other than the binary behavior described above (runoff and infiltration beyond the root zone occur if the soil is at or above field capacity).

Recommendation: A more realistic water balance algorithm needs to be implemented into the PAT terrestrial module. This algorithm should acknowledge that runoff and infiltration are dependent on soil saturation and many other factors (soil hydraulic conductivity, slope, surface roughness, etc.). In addition, other processes essential to the water balance such as evapotranspiration need to be considered. As an example, the curve number based PRZM algorithm could be used. All necessary inputs are available as PRZM needs to be run prior to running PAT. In addition, errors in the manual need to be corrected to be consistent with the code.

All Pesticide Mass (Soluble and Sorbed) Coming from the Treated Field is Instantaneously Distributed Across the T-PEZ: All pesticide mass incoming from the treated field is instantaneously distributed across the T-PEZ (see Section 4.1.3 Pesticide Loadings to the T-PEZ in the PAT manual and Section 4.1.4 Plant Exposure in the T-PEZ) and assumed to 'interact' with the T-PEZ. This is problematic because runoff out of the T-PEZ and infiltration below the T-PEZ active root zone only occur if:

(a) the incoming water volume exceeds the available T-PEZ holding capacity, which is artificially increased when soil water content is set to wilting point every day without runoff or rainfall inputs or
(b) the T-PEZ is already at its holding capacity.

In both cases a significant amount of runoff and loadings will 'flush' through the T-PEZ without the potential to interact with the plants. However, due to PAT's simplistic water balance equations, the potential of runoff and loadings 'flushing' through the T-PEZ is artificially decreased. This is caused by unrealistically setting the soil moisture condition to wilting point on all days without rainfall or runoff, without acknowledging soil moisture conditions from the previous time step. Thus, the run-off deposition is highly overestimated in cases where the T-PEZ is already at or close to saturation.

Recommendation: The transport and fate algorithms of the PAT terrestrial module need to be revised. Especially in cases where runoff events occur at a time where the T-PEZ is already at saturation. In those cases, the incoming runoff and their loadings are not expected to interact with the T-PEZ and should not contribute to plant exposure. More specifically, the amount of runoff infiltrating into the T-PEZ needs to be calculated and only the pesticide mass associated with the runoff infiltrating into the T-PEZ should contribute towards the plant exposure. Pesticide loadings that are just flowing over the T-PEZ should not contribute towards terrestrial exposure. With the current approach it is not possible to calculate the amount of runoff infiltrating into the T-PEZ because of the simplistic implementation of the water balance where leaching below the T-PEZ and runoff out of the T-PEZ are calculated in one term. PRZM could be used to solve the hydro-chemical mass balance for a more realistic representation of hydrologic, fate, and transport processes. All model input requirements for this type of approach are readily available, as PZRM simulations are already a required component of PAT.

All Sediment Is Assumed to Deposit (and Stay) in the T-PEZ: All incoming erosion from the treated field is assumed to stay in the T-PEZ. This is unrealistic and overly conservative. Depending on the magnitude of the runoff event and many other parameters (e.g., slope, soil saturation) not all sediment will deposit in the T-PEZ. Thus, a fraction of sediment and sorbed pesticide mass will never interact with the T-PEZ.

Recommendation: A sediment transport and deposition module needs to be developed that acknowledges that a fraction of sediment and its sorbed pesticide flushes through the T-PEZ. This fraction should not contribute to plant exposure. As suggested above, PRZM could be used as a more realistic landscape mode to calculate the fraction of water that infiltrates. It could then be assumed that the same fraction of erosion is deposited. Alternatively, a mechanistic model such as VFSMOD (Muñoz-Carpena and Parsons, 2004) could be used, or a metamodel based on VFSMOD could be used to estimate sediment and sorbed pesticide deposition in the T-PEZ.

The PAT Wetland Module is a New Tool Designed to Refine Screening-Level Exposure Estimates: New software often contains bugs and errors when initially released. This was observed in PAT for the T-PEZ calculations.

Recommendation: A new model or tool should go through an SAP before being used in assessments. The scientific community and all stakeholders should get the opportunity to review and test PAT before it is being used in any risk assessment including the biological evaluations produced by the EPA.

PAT Converts All Pesticide in Water to a Terrestrial Concentration (lbs./A): A terrestrial concentration / endpoint does not apply when there is standing water and terrestrial concentrations should only be considered when the water depth is below 0.5 cm (which is the threshold when aquatic concentrations are ignored) (EPA, 2020b).

Recommendation: The PAT wetland module should only consider terrestrial EECs when the water depth is less than 0.5 cm (and only consider aquatic EECs when the water depth is greater than or equal to 0.5 cm).

Assuming All Off-Field Runoff and Pesticide Loadings Enter the W-PEZ Is Extremely Conservative for Buffer Distances Greater Than Zero: The W-PEZ conceptual model assumes that all runoff and its loadings from a treated field, which is more than 10 times larger than the wetland itself, enters the wetland water body. While the assumption that 100% runoff and pesticide load from field enters the water body might be a realistic worst-case scenario if the wetland is immediately adjacent to the field, it becomes increasingly unrealistic if there is a buffer (i.e., non-cropped and treated area) between the field and the wetland. Even if there is only a small buffer distance between edge of field and wetland, there will be runoff and pesticide losses due to infiltration and sedimentation (as assumed by the T-PEZ conceptual model) and contributions of flow from untreated areas (i.e., the percent cropped area will be less than 1.0).

Recommendation: The PAT wetland conceptual model is extremely conservative which should be acknowledged in the documentation. For refined simulations, the user should be provided with an option (i.e., an input parameter) to scale the amount of runoff and loadings into the W-PEZ module to a realistic level, accounting for typical Percent Crop Areas (PCAs), reduction in load due to infiltration before reaching the wetland, and Percent Crop Treated (PCT).

PAT Is Not a Stand-Alone Model: In the manual, PAT is described as a stand-alone model that uses existing algorithms from the Pesticide Root Zone Model (PRZM) and the Variable Volume Water Model (VVWM) for EECs in runoff and waterbodies. AgDRIFT is used to calculate off-target spray deposition to areas adjacent to the treated field. All individual components of the model (PWC (PRZM, VVWM), AgDRIFT) have to be setup and run before PAT can be executed. This can lead to user errors because the user has to point PAT to the required individual files (e.g., *.swi (PWC), *.zts (PRZM), *_daily.csv (VVWM)). In addition, PAT uses drift curves exported by AgDRIFT, but the algorithms itself are not used for calculating off-target spray deposition.

Recommendation: To avoid user errors, PAT should be setup with a minimal set of input files (e.g., *.swi file, drift curves, and toxicity endpoint) and execute PRZM and VVWM. Ideally, PAT could be integrated into PWC.

PAT Code Documentation: PAT is implemented in Python and uses several external libraries (e.g., Pandas and NumPy). For transparency and making results reproducible, the version numbers of the external libraries should be stated.

Recommendation: The manual and code should include the version numbers of the external libraries used.

PAT Code Execution: As currently implemented, the user is required to make changes to the python code inside the PAT 'main' function for changing inputs and settings. This means that technically the user must change the PAT code for each model run.

Recommendation: The main PAT function should include all relevant parameters as arguments. This will enable the user to run PAT without having to change the PAT code. In addition, the generation of a truly stand-alone PAT version running without the need of having a Python interpreter and IDE installed should be considered.

There Is a Conflict Between the Version Number on the Code Provided in EPA-ESA Git-Hub Repository and the Version Number Stated in the Manual: The current PAT manual refers to PAT version 1.0. The latest version of the python code, however, indicates that it is version 2.1. The PAT python code itself does not state a version number but the python code filename is labeled as 'pat v2.1.py'. Some parts of the manual reference the PAT python code as 'pat_v2.py'.

Recommendation: For transparency and reproducibility reasons, the PAT python code and the PAT manual should have matching version numbers with the manual reflecting all changes between versions.

Several PAT Versions are Distributed Through Official EPA Channels: As stated in the beginning of this section, multiple PAT versions with significant differences are available. The version hosted on EPA's official GitHub repository (pat v2 012420) contains a function for calculating spray drift deposition that returns wrong results for most setback distances.

Recommendation: All official EPA distribution channels should provide the latest version of the code accompanied by documentation reflecting changes between versions.

5 Exposure Refinements

5.1 Water Monitoring Data

The draft Thiamethoxam BE relies on model-estimated concentrations and reports these values as "a suitable upper bound concentration for thiamethoxam". Syngenta agrees that thiamethoxam detected in surface water vary but is markedly lower than model-estimated concentrations presented in the draft BE. In this section, we develop daily pesticide chemographs from non-daily sampling data from two monitoring sites in Minnesota using the Seawave-QEX model (Vecchia, 2018). This was done to demonstrate the use of sparse monitoring data as a refinement option for the Pesticide Water Calculator (PWC). Findings from high-frequency targeted monitoring data taken from streams within vulnerable watersheds in the US Midwest and Ontario, Canada are provided below and show consistency in magnitude with the levels of thiamethoxam detects referenced in Appendix 3.3 of the draft BE. In addition, ratios of thiamethoxam and clothianidin (a degradate of thiamethoxam) detects from a farm pond study and monitored wetlands in Canada are presented to contextualize the relative contribution of clothianidin to the thiamethoxam residues of concern as defined in the BE. Syngenta encourages the Agency to continue to develop approaches to refine exposure to alleviate the conservative predictions included in this and further evaluations.

5.1.1 SEAWAVE-QEX Modeling

SEAWAVE-QEX is mentioned in the draft Thiamethoxam BE as a tool the EPA is investigating to incorporate monitoring data into the risk assessments in the future. Syngenta supports this effort and recognizes that thiamethoxam data are publicly available to evaluate this higher-tier tool. Water monitoring data were obtained from the National Water Quality Monitoring Council's Water Quality Data Portal (USEPA & USGS) for two locations. These stations had sufficient data to meet the SEAWAVE-QEX model minimum requirements (3 years of data of 6 or more samples and greater than 30% detects per year). The location identifiers are MNDA_PESTICIDE-S001-210 (a.k.a S001-210) and MNDA_PESTICIDE-S004-383 (a.k.a. S004-383). Table 5.1.1-01 provides a breakdown of the years of data available and the rate of detects for each site. Both stations are in southern Minnesota, where the agricultural land use is primarily corn and soybean (Figures 5.1.1-01 and 5.1.2-02).

The concentrations reported for the two stations are generally within the same range. The maximum values were 0.277 and 0.248 ppb for S-001-210 and S-004-383, respectively. Descriptive statistics for each site are provided in Figure 5.1.1-03.

Table 5.1.1-01. Thiamethoxam monitoring data retrieved the Water Quality Portal

Location Id	Years	Samples	No. of Detects	Percent Detects
S001-210	10	101	32	31.7
S004-383	7	61	22	36.1

Figure 5.1.1-01. S001-210 monitoring stations

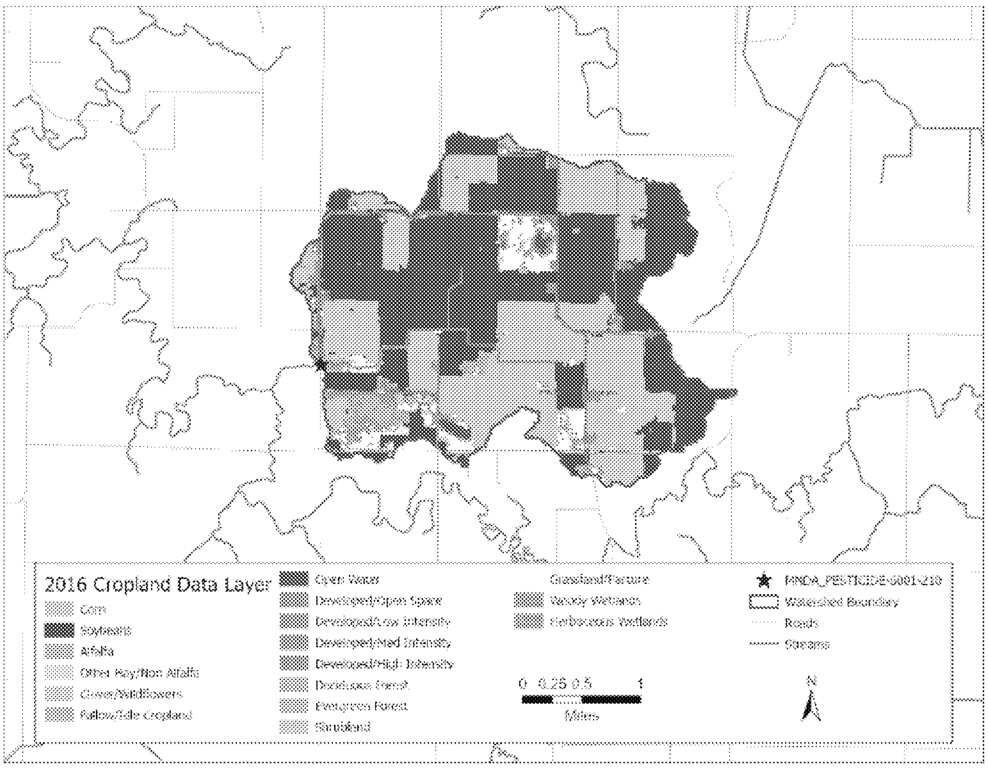


Figure 5.1.1-02. S004-383 monitoring stations

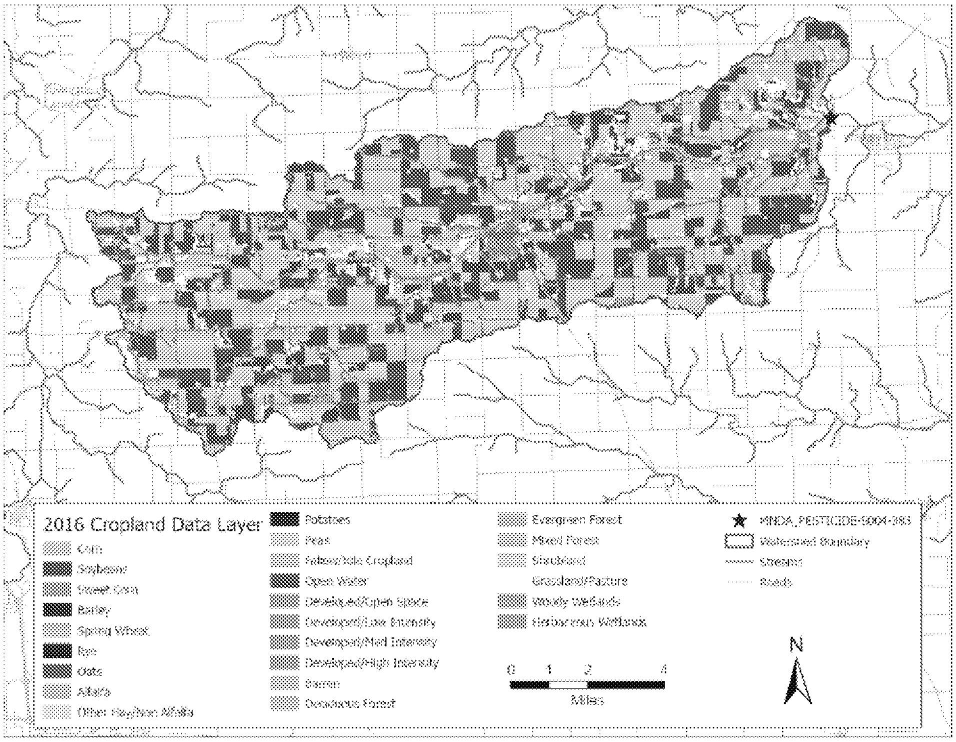
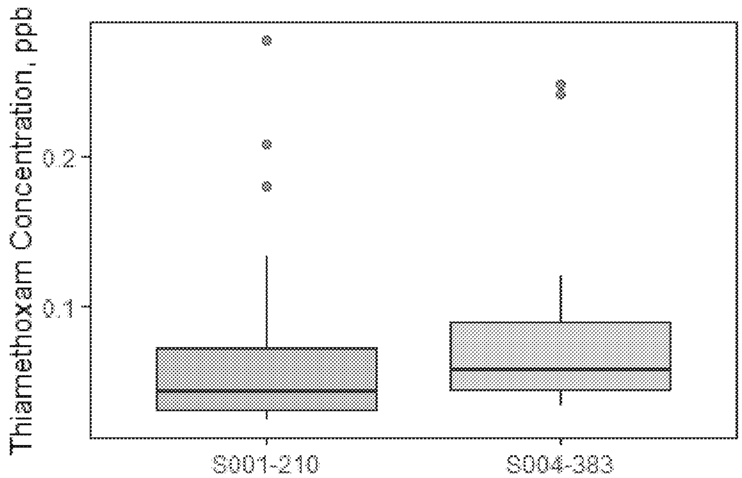


Figure 5.1.1-03. Descriptive statistics for data collected at stations S001-210 and S004-383 in southern Minnesota.



Station	Mean	Median	90th %ile	Minimum	Maximum
S001-210	0.066	0.043	0.132	0.025	0.277
S004-383	0.081	0.058	0.119	0.033	0.248

Methodology

The SEAWAVE-QEX model was setup and run following the methodology outlined by the USEPA in their SEAWAVE-QEX standard operating procedure (SOP) and White Paper (US EPA, 2019a; 2019b). After thiamethoxam monitoring stations, meeting SEAWAVE-QEX model requirements, were identified (S001-210 and S004-383), the corresponding chemical concentration datasets were prepared for input into the model, including updating the input file format and setting each dataset's associated limit of detection (LOD) and reporting limit. From corresponding metadata, the LOD was determined to be 0.025 ppb for both datasets. Therefore, concentration data labeled as "Not Detected" were assigned a value equal to the LOD (0.025 ppb) and were flagged as censored for input into the model. Since the reporting limit was not listed in the corresponding metadata, concentration data labeled as "Below Reporting Limit" were assigned a value equal to the LOD but were not flagged as censored for input into the model.

Since SEAWAVE-QEX was developed for use with streamflow as a covariate, daily flow data were downloaded and prepared for input into the model. Daily flow data were acquired for each monitoring station from the Minnesota Department of Natural Resource's website (MN DNR, 2021). The flow monitoring station IDs associated with monitoring stations S001-210 and S004-383, were 3207300 and 41040001, respectively. For both flow monitoring stations, daily flow data were missing during the winter months. Missing flow data were infilled using the average flow data from the prior and subsequent 15 days. Also, for monitoring station S001-210, no flow data were available in 2018 and 2019, thus these years were not simulated by SEAWAVE-QEX using the streamflow covariate.

Due to the incomplete daily flow datasets that were available for use with SEAWAVE-QEX, daily precipitation data were downloaded and prepared for input as an alternative covariate into the model. Daily precipitation was acquired for each monitoring station from the Minnesota Department of Natural Resource's website (MN DNR, 2021). The weather station IDs associated with monitoring stations S001-210 and S004-383, were 219046 and 219249, respectively. Rainfall data labeled as missing or trace, were assigned a value of zero. Following the methodology outline by the USEPA in their SEAWAVE-QEX SOP (US EPA, 2019b), both precipitation datasets were transformed, using the antilog of the cube root, for model input.

After data were prepared for input into SEAWAVE-QEX, the model was setup and run using default values for fitting. Once run, model results, including daily estimated concentrations for thiamethoxam, and diagnostic plots were evaluated following the USEPA's SEAWAVE-QEX SOP (US EPA, 2019b).

Model Results

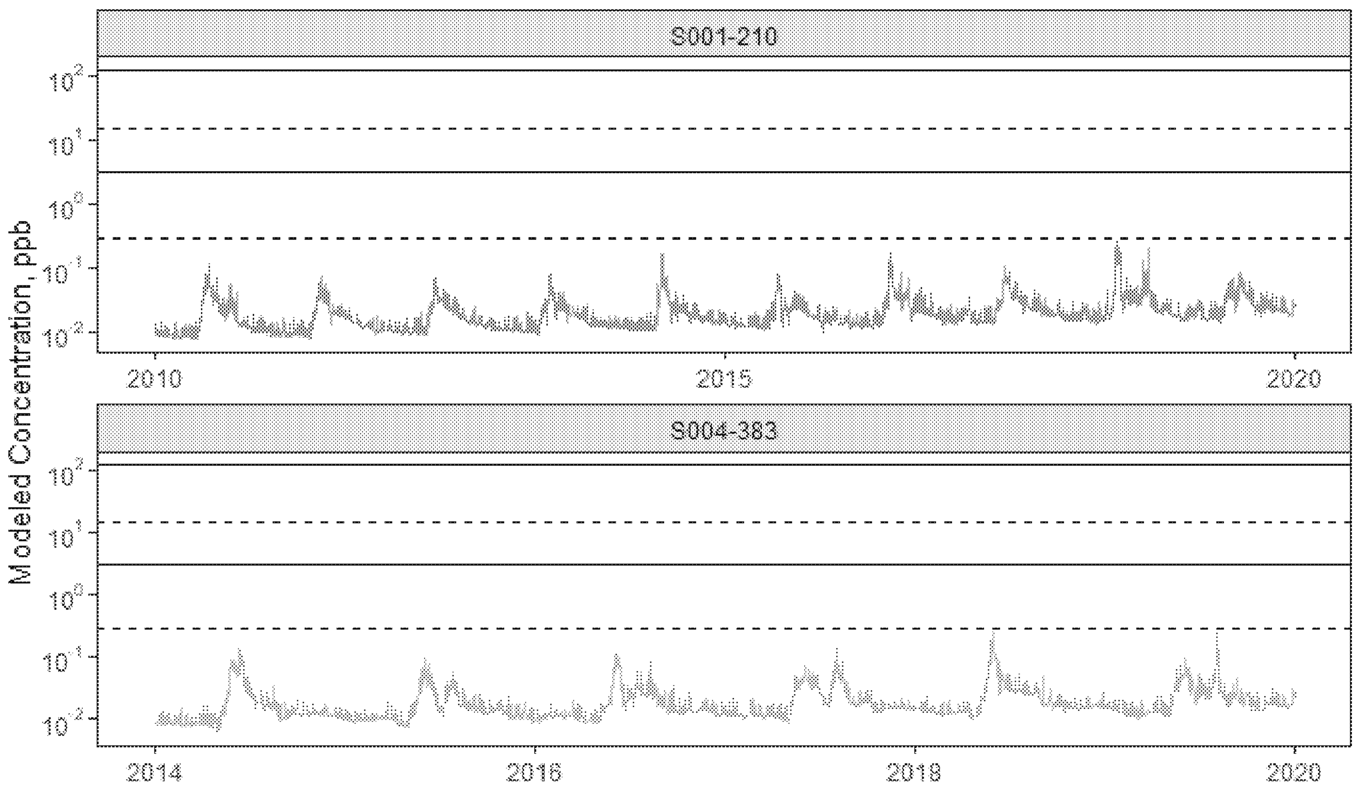
SEAWAVE-QEX results were compared with those obtained from PWC for aquatic bins 2 (low flow) and 4 (high flow) (Figure 5.1.1-04). PWC results for HUC02-7 were selected since stations S-001-210 and S-004-383 collocate with this region. For bin 2, the daily EECs (1-in-15) ranged from 3 – 119 ppb and 0.29 – 14.56 ppb for bin 4. Annual peak concentrations from SEAWAVE-QEX are within an order magnitude for the minimum concentration reported for bin 4. However, the upper bound peak PWC concentrations exceed SEAWAVE-QEX estimates by up to 2-3 orders of magnitude.

The maximum annual 21-day rolling average was 0.134 ppb for S001-210 and 0.096 ppb for the S004-383.

There are several uncertainties to note when comparing the SEAWAVE-QEX results (Figure 5.1.1-04) with the results from PWC HUC02-7 bin 2 and bin 4. Bin 2 results from PWC are edge-of-field concentrations. Bin 4 is modeled in PWC as a 173-ha watershed transporting mass into a 5.26 ha by 2.74 m deep reservoir (144,124 m^3 volume). The size of the watersheds S-001-210 and S-004-383 are 1921 ha and 27389 ha, respectively. These larger, highly cropped watersheds, shown in Figures 5.1.1-01 and 5.1.1-02, show lower monitored concentrations than the PWC modeled watersheds. The PWC modeling is highly conservative with applying on the wettest month, using the maximum application rates, and number of applications. The SEAWAVE-QEX concentrations most likely reflect typical usage and timing. Additionally, PWC concentrations from bin 4 assume the fields are in close proximity to a waterbody with wind always blowing towards the waterbody to cause drift. Bin 4 simulations don't take into account any Best Management Practices that the farmers may be utilizing. The PWC model uses the Des Moines, IA (w14933) weather station that has annual precipitation ranging from 55.5 to 114.8 cm (1961 to 1990). The weather station that was used for SEAWAVE-QEX has higher minimum and maximum annual precipitation ranging from 66.8 cm to 131.6 cm.

The refinements provided by the SEAWAVE-QEX model to predict exposure demonstrate the need to include higher-tier approaches in the assessment process. At a minimum, these modeling results should be included as part of a weight-of-evidence to contextualize environmentally relevant thiamethoxam exposure.

Figure 5.1.1-04. Thiamethoxam daily concentration predicted by SEAWAVE-QEX where rainfall was used as a surrogate for the streamflow covariate. The solid and dashed black horizontal lines represent the range of HUC02-7 EECs estimated for aquatic bins 2 and 4, respectively.

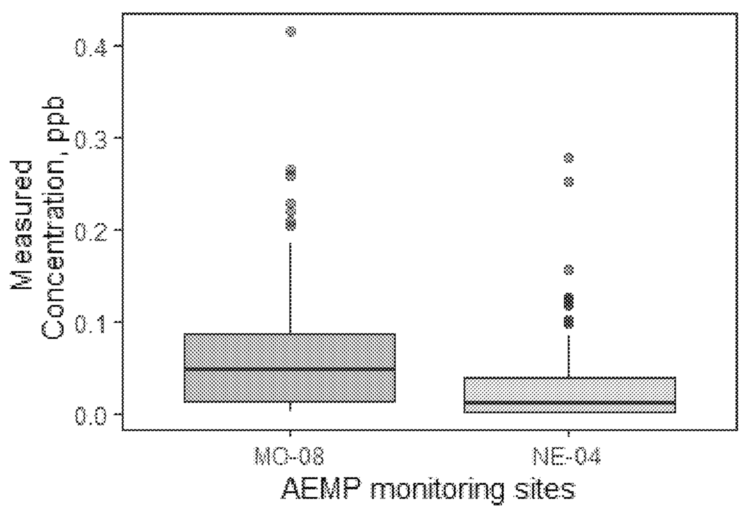


5.1.2 Thiamethoxam Monitoring at two AEMP monitoring sites

Targeted monitoring of thiamethoxam in areas that have a likelihood of pesticide occurrence in water is not available on a wide scale. Thus, Syngenta designed a program in 2021 to monitor thiamethoxam concentrations in streams of highly vulnerable watersheds. Daily composite samples were collected from the streams during the crop growing season to ensure peak concentrations were captured and to assess the magnitude and frequency of thiamethoxam exposure. The samples were collected from March to August from two Atrazine Ecological Monitoring Program (AEMP) monitoring sites (MO-08 and NE-04) in the Midwest. Figure 5.1.2-01 compares the distribution of the concentration in both streams. Daily thiamethoxam concentrations at these two sites are provided in Appendix 3.1. On dates where the reported concentration is below the limit of quantitation (LOQ = 0.005), ½ LOQ is imputed to those time points. Approximately 13% of the samples taken at the MO-08 sites were less than LOQ. The fraction of the samples <LOQ at NE-04 was ~30%.

For MO-08, maximum, 90th percentile, 50th percentile, and average concentrations were 0.4147, 0.1509, 0.0470, and 0.0638 ppb, respectively. For the NE-04 site, concentrations were generally lower with maximum, 90th percentile, 50th percentile, and average concentrations of 0.2777, 0.0902, 0.0108, and 0.0307 ppb, respectively. The maximum annual 21-day rolling averages were 0.1481 ppb and 0.1008 ppb for MO-08 and NE-04, respectively. These concentrations are comparable to the observations reported for S001-210 and S004-383 described in the previous section.

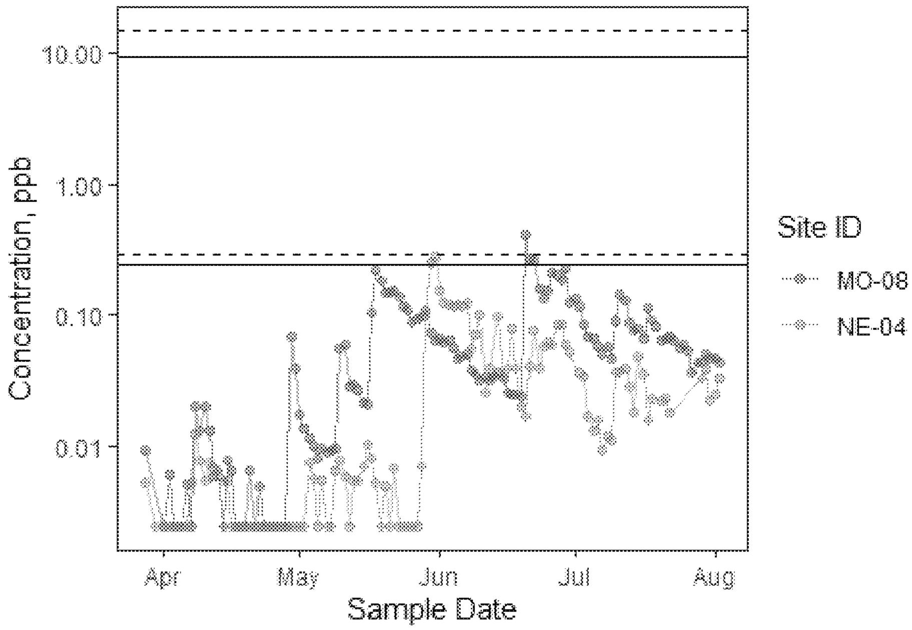
Figure 5.1.2-01 Range of thiamethoxam concentration at two AEMP monitoring sites.



The NE-04 and MO-08 sites are located in regions 10 and 7, respectively. Therefore, a comparison of the modeled EECs and measured concentrations were made accordingly. While it is understood that the model-estimated concentrations are not site-specific and were not parameterized for the NE-04 and MO-08 locations; Syngenta believes that comparisons of the measured and modeled exposure add to the weight-of-exposure.

Measured peak concentrations are only comparable with the lower end of the EEC range reported for HUC02-7 and HUC02-10b (Figure 5.1.2-02). Short-term pulses of thiamethoxam were observed; however, dissipation was relatively rapid at the two sites.

Figure 5.1.2-02. Daily thiamethoxam concentration at the MO-08 and NE-04 monitoring sites. The horizontal solid lines represent PWC minimum and maximum peak EECs generated for aquatic bin 4 and HUC2-10b. The horizontal dashed lines represent PWC minimum and maximum peak EECs generated for aquatic bin 4 and HUC2-7.



Daily concentrations for each site are provided Appendix 3.1.

5.1.3 Surface Water Monitoring in Wetlands in Canada

5.1.3.1 Ontario

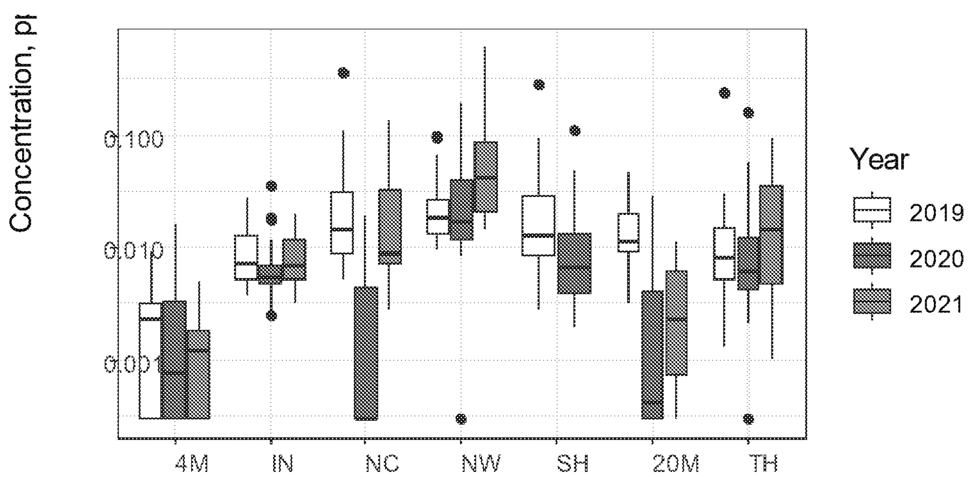
Syngenta has conducted weekly monitoring of several waterways in Ontario, Canada, to determine neonicotinoid concentration levels. Three consecutive years of monitoring data are available for all monitoring sites (Table 5.1.3-01), except for the Sydenham River location, where monitoring data are only available for 2019 and 2020. For samples reported as "no detect", ½ limit of detection (LOD) was imputed into the data tables for completeness. The analytical LOD for thiamethoxam and clothianidin was 0.0006 ppb and 0.002 ppb, respectively. Raw data and descriptions of the sites are available in the Attachment TK0474277_Ontario watersheds 2019 to July 2021.xlsx.

Table 5.1.3-01. Location of surface water monitoring sites sampled on a weekly basis in Ontario

Site ID	Full Name	Watershed Size (ha)	Sampling point latitude	Sampling point longitude
4M	4 Mile Creek	43.0	43.253	-79.126
20M	20 Mile Creek	292	43.152	-79.374
NC	North Creek	36.4	43.074	-79.525
IN	Innisfil Creek	481	44.131	-79.797
NW	Nottawasaga Creek	30.0	44.221	-79.828
TH	Thames River	1255	43.214	-81.211
SH	Sydenham River	1071	42.650	-82.009

Over the three years, the maximum concentration reported across all sites was 0.61 ppb at the Nottawasaga Creek sample location. This concentration is comparable to findings reported in Struger et al. (2017), where the maximum measured thiamethoxam concentration was 1.34 ppb. There is no significant difference between the annual concentration across the sites except for North Creek, where "no detects" were reported for greater than 50% of the samples in 2020.

Figure 5.1.3-01. Thiamethoxam concentration in surface water monitored weekly in Ontario.



Surface water monitoring was conducted at two additional waterways (Horner Creek and Nith River) in Ontario in 2021; however, samples were collected on a daily basis.

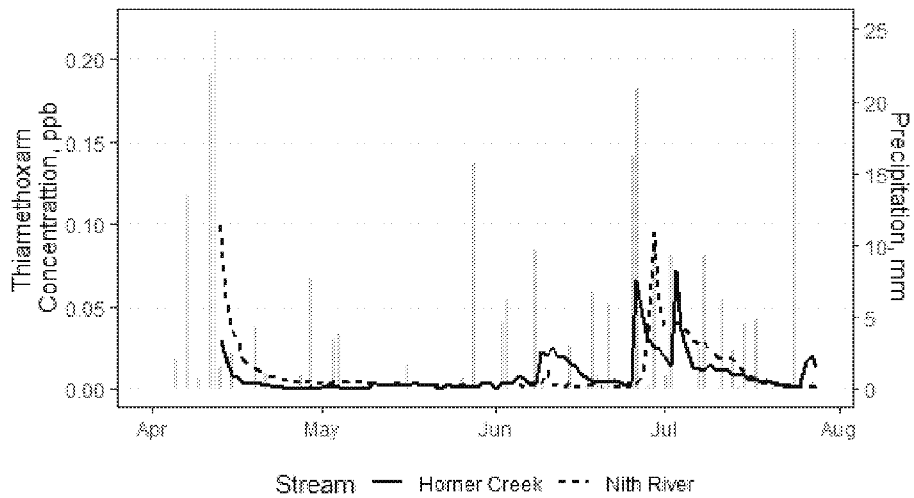
Site ID	Full Name	Watershed Size (ha)	Sampling point latitude	Sampling point longitude
HC	Horner Creek	77.4	43.267	-80.683
NR	Nith River	611	43.315	-80.641

Spikes in thiamethoxam concentration correlated with rainfall events but dissipated quickly shortly afterward (Figure 5.1.3-02). Thiamethoxam levels were relatively low in the two streams. The highest concentration (0.099 ppb) was observed at the Nith River, while concentration at the second location peaked at 0.072 ppb. The maximum 21-day rolling average for thiamethoxam was 0.022 and 0.028 ppb for Horner Creek and Nith River, respectively. Summary statistics of thiamethoxam concentrations observed are provided in Table 5.1.3-02.

Table 5.1.3-02. Summary statistics for thiamethoxam concentrations detected in water at the Horner Creek and Nith River sampling locations.

Stream	Average	Minimum (ppb)	Maximum (ppb)	10th percentile (ppb)	50th percentile (ppb)	90th percentile (ppb)
Horner Creek	0.0085	0.00015	0.072	0.00055	0.0037	0.0208
Nith River	0.0110	7.00E-04	0.099	0.00128	0.0035	0.030

Figure 5.1.3-02. Thiamethoxam concentrations detected in water at the Horner Creek and Nith River sampling locations



ED_006569J_00017408-00048

5.1.3.2 Saskatchewan

A study similar to the one described above for Ontario was conducted in Saskatchewan (MRID 51485101). In this study, 56 wetlands of varying sizes, depth, and location (i.e. within the field or on field edges) were selected to determine concentrations and dissipation of thiamethoxam and other neonicotinoids in surface water. These wetlands were located within fields that had been planted in 2018 with seeds commercially treated with thiamethoxam. The maximum acute concentration of 1.85 ppb was observed at the site identified as MT1 (Figure 5.1.3-03); however, this pulse in thiamethoxam concentration coincided with significant rainfall (MRID 51485101). The disappearance rate of thiamethoxam was relatively rapid in this wetland (~2 days). The wetland with the highest chronic exposure to thiamethoxam was calculated at 0.099 ppb; the majority of wetlands exhibited chronic exposure <0.02 ppb.

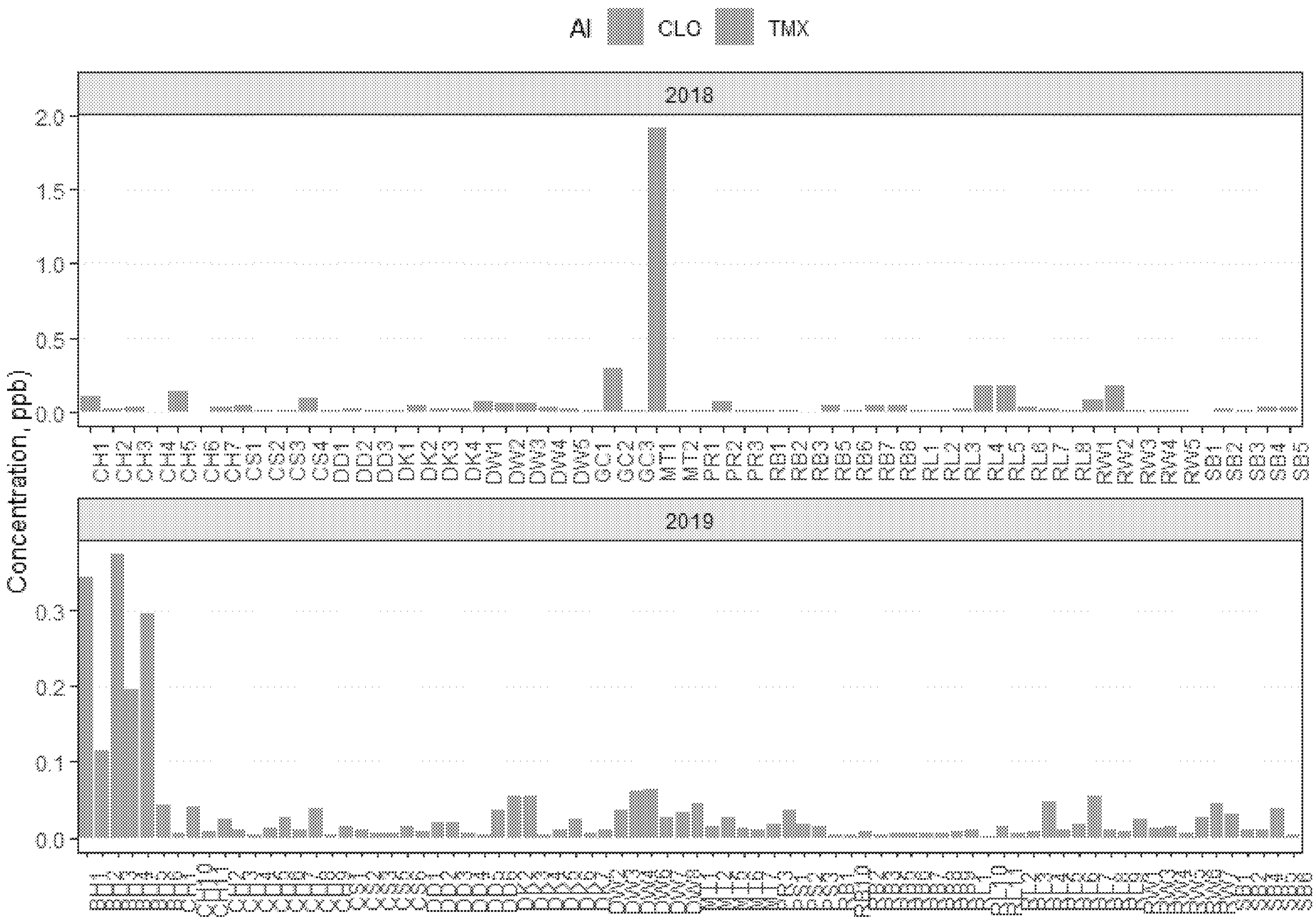
Sampling continued in 2019 in sixty (60) wetlands; 23 of the sites were monitored in 2018 and an additional 37 wetlands where neonicotinoid concentrations were measured (Attachment - TK0384563_Prairie wetlands 2019_ Supplementary report.xlsx). The range in magnitude was similar to the previous year where the peak concentration for thiamethoxam across all sites was 0.270 ppb (Figure 5.1.3-03).

Comparison of the concentrations of the degradate compound, clothianidin, to thiamethoxam showed that clothianidin contributes a relatively small fraction to the aggregate thiamethoxam residues of concern (Figure 5.1.3-03) assessed in the biological evaluation. The median values of the quotient of peak clothianidin and thiamethoxam concentration were 0.33 and 0.27 for 2018 and 2019, respectively. Specifically, the median concentrations in 2018 were 0.014 ppb and 0.007 ppb for thiamethoxam and clothianidin, respectively (Table 5.1.3-03). The median concentrations across the sites monitored in 2019 were marginally lower.

Table 5.1.3-03. Summary of clothianidin and thiamethoxam concentrations across the Saskatchewan monitoring sites

Year	Chemical	5th percentile (ppb)	50th percentile (ppb)	95th percentile (ppb)
Peak				
2018	Thiamethoxam	0.0035	0.0143	0.155
	Clothianidin	0.001	0.0066	0.027
2019	Thiamethoxam	0.0025	0.0095	0.071
	Clothianidin	0.001	0.002	0.033
21-day average				
2018	Thiamethoxam	0.0012	0.0063	0.062
	Clothianidin	0.001	0.0028	0.013
2019	Thiamethoxam	0.0003	0.0052	0.054
	Clothianidin	0.001	0.0032	0.022

Figure 5.1.3-03. Peak thiamethoxam (TMX) and clothianidin (CLO) concentrations in monitored wetlands in 2018 and 2019



5.1.4 Pond Runoff Study

A pond runoff study was initiated during the 2021 growing season in northeastern Missouri where soybean and corn are commonly grown and rotated on an annual or biannual basis. The objective of the study was to determine the contribution of clothianidin in surface water (pond) from an application of thiamethoxam applied as a seed treatment in the surrounding adjacent field (Figure 5.1.4-01).

Figure 5.1.4-01. Pond runoff study site location in Missouri

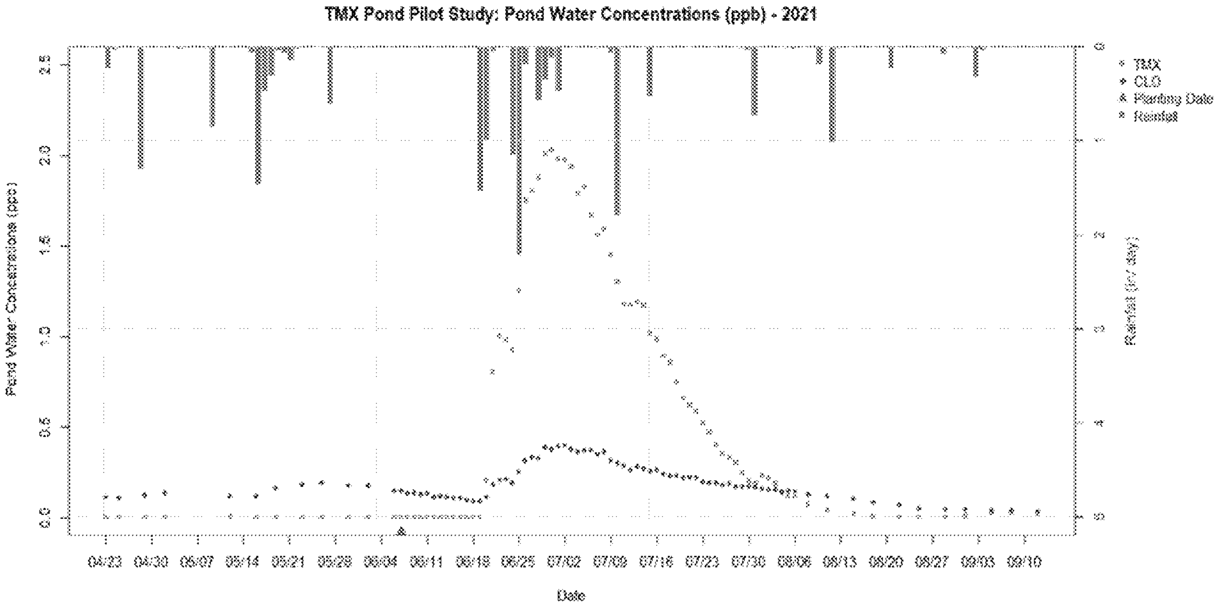
Descriptions of the field and pond are included in MRID 51176405 (Moore et al., 2020). Daily composite samples were collected for two months post-planting and twice weekly thereafter. Thiamethoxam and clothianidin concentrations in the pond correlated with rainfall events (Figure 5.1.4-02). Clothianidin concentrations ranged from 0.035 to 0.4 ppb, while thiamethoxam concentrations ranged from below LOQ to 2 ppb. Detections below method LOQ (0.005 ppb) are reported as ½ LOQ. Daily concentrations are tabulated in Appendix 3.2.

The disappearance time (DT50) for thiamethoxam in the pond was 11 days, and the maximum 21-day rolling average reported after the peak was observed was approximately 1.4 ppb. The 50th and 90th percentile levels for the 21-day chronic exposure durations were 0.53 and 1.2 ppb, respectively. With mitigations, such as a maintained vegetative filter strip, thiamethoxam detects would be expected to be reduced.

The ratio of clothianidin and thiamethoxam concentrations was calculated from measurements taken after the first post-plant precipitation event. This approach was taken since the field was planted with seeds coated with Poncho® 500, a clothianidin seed treatment product, in 2020 (see Site maintenance record in Appendix 3.3), and runoff from the field contained background clothianidin residues as a result of the prior year's application.

On average, the ratio of clothianidin to thiamethoxam in the pond was approximately 0.2.

Figure 5.1.4-02. Pond water concentration from 2021 monitoring study in Missouri



5.1.5 Summary

For thiamethoxam, detects in surface water (streams, wetlands and a farm pond) ranged from below LOQ to ~2 ppb. These values are only comparable to the lower bound estimates reported in the draft BE for high flow aquatic bins and well below the 30-years of daily maximum values for use in the MAGtool.

Use of monitoring to benchmark model-estimated surface water concentration should be an integral part of the BE framework. As is acknowledged by Agency in BE and demonstrated in this section, modeled EECs overrepresent likely environmental exposure. The impact of this conservative approach propagates throughout the evaluation and ultimately exaggerate the number of listed species designated as LAA.

References

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Minnesota Department of Natural Resources 500 Lafayette Road St. Paul, MN 55155-4046

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5.2 Foliar DT50

As stated in the Executive Summary in Attachment 3-2 of the draft Thiamethoxam BE "*…because the decline curve of the default T-REX EECs is calculated using a default foliar dissipation half-life of 35 days and the exceedances of the default T-REX EECs usually occurred within the first week after foliar application, there is an opportunity for risk assessors to refine the default T-REX EECs using chemical-specific foliar dissipation rates in order to more realistically estimate residues in leaves more than a week after the foliar application*". Using studies containing leaf residue data where foliar applications of thiamethoxam were made to crops that were previously submitted to the Agency and six additional studies (3 for lettuce and 3 for tobacco, MRID 51485112, 51485109, 51485108, 51485111, 51485110, 51485113) being submitted in support of this analysis, Syngenta has determined a refined foliar DT50 for thiamethoxam. To determine the dissipation rate of thiamethoxam in each of these studies, the single first order (SFO) model was applied to each dataset using the Computer Assisted Kinetic Evaluation (CAKE) (v3.4) user interface. The SFO fit was deemed appropriate either because the number of sampling time points (less than 4) or it best characterizes the residue decline over the sample period. The resulting DT50 values for each study are shown in Table 5.2-1. The average DT50 was determined to be 3.3 ± 2.5 days. Syngenta recommends the Agency use the refined DT50 in the T-REX model as a refinement.

5.3 Seed Treatment DT50

Although foliar application scenarios were primarily used in the draft Thiamethoxam BE to cover seed treatment uses, Syngenta would like to remind EPA that thiamethoxam seed treatment decline studies have been submitted to the Agency (MRID 50553001; 50553002). Although there is currently not an input for seed treatment DT50 values in T-REX as there is for foliar uses, these studies can be used to determine a DT50 for treated seeds for use as weight of evidence that long term exposure to residues on treated seeds is not consistent over time.

Two seed treatment decline studies were included in this analysis, with three replicates per study; for each replicate, seeds were sampled nine times (days 0, 1, 2, 3, 5, 7, 10, 14 and 21) for residue analysis. For oilseed rape, seed was scattered onto the soil surface in a single layer at a rate of 500 seeds/m^2; for corn, seeds were laid out on flat bare soil with spacing between individual seeds representing unincorporated seed that could be available for consumption by wildlife. To determine the dissipation rate of thiamethoxam in each of these studies, the single first order (SFO) model was applied to each dataset using the Computer Assisted Kinetic Evaluation (CAKE) (v3.4) user interface. The SFO fit was deemed appropriate because it best characterized the residue decline over the sample period. The resulting DT50 values are shown in Table 5.3-1; the average DT50 was 10.7 ± 0.5 days.

Table 5.2-1. Foliar DT50 values determined from various studies containing leaf residue data from foliar applications of thiamethoxam.				
Sample Type	**Length of Study (days)**	**Number of Timepoints**	**DT50 (days)**	**MRID**
Mock Orange Leaves	119	6	1.64	50425903
Common Lilac leaves	98 103	6	4.76	50425903
Apple leaves	57 60	6	3.58	50265504
Soybean leaves	62	6	1.04	50265503
Cucumber leaves	60	6	1.26	49804105
Tomato leaves	75	6	1	49804101
Strawberry leaves	56	4	2.04	50265502
Lettuce leaves	21	5	2.35	51485112
	14	4	1.44	51485109
	14	5	5.99	51485108
Tobacco leaves	21	4	9.29	51485111
	35	6	3.4	51485110
	14	3	3.2	51485113
Average ± SD			**3.3 ± 2.5**	

Table 5.3-1. DT50 values determined from various seeds treated with thiamethoxam.				
Seed Type	**Length of Study (days)**	**Number of Timepoints**	**DT50 (days)**	**MRID**
Corn	21	9	14.3	50553001
Oilseed Rape	21	9	7.0	50553002
Average ± SD			**10.7 ± 0.5**	

5.4 Field Drift Study

The Agency uses the AgDRIFT model as a component of the MAGtool and PAT to estimate the contribution of exposure from spray drift of foliar applications. It has been demonstrated in field drift studies that the AgDRIFT model overpredicts off-field deposition compared to measured values, especially in the far field (Bird et al. 2002; Brain et al. 2017, 2019). A field drift study was conducted with Actara® 25WG, a water-dispersible granular formulation of thiamethoxam, at the maximum registered foliar application rate (0.086 lbs. ai/A; 96 g ai/ha) using three standard nozzle types with spray droplet size ranging from fine (XR11003 nozzle) to very course (AIXR11002 nozzle) (Perine et al. 2021).

As demonstrated in Bird et al. (2002) and Brain et al. (2017, 2019), results of this study also showed that the AgDRIFT model overpredicts deposition compared to the measured values (Figure 5.4-1).

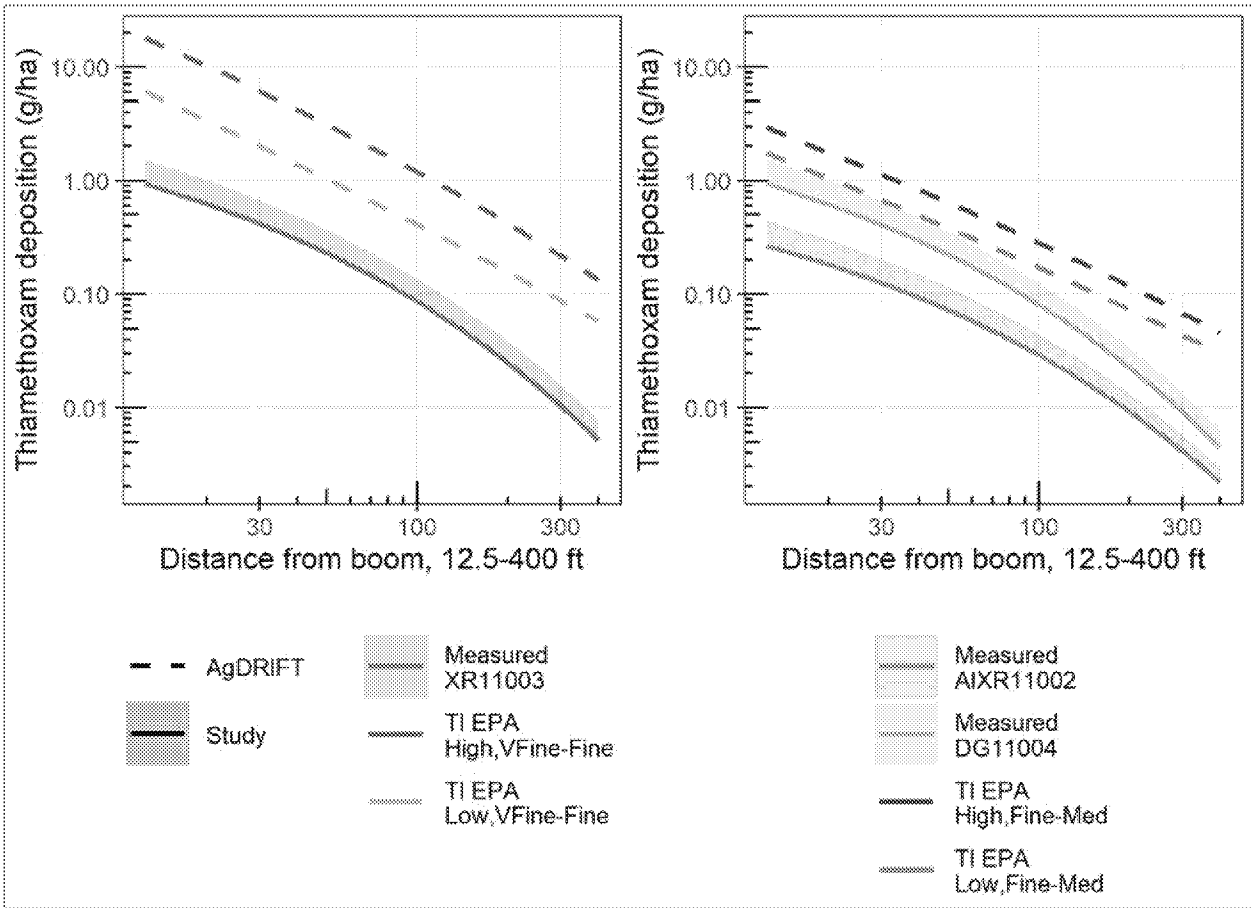

Figure 5.4-1. Solid lines represent the field-measured deposition values from three nozzles used and the dashed lines represent AgDRIFT predicted deposition values based on Tier 1 boom height (high, low) and droplet size spectrum (very fine-fine; fine-medium). (From Figure 4 in Perine et al. 2021).

Using the drift curves generated from the field deposition data, estimated off-field exposure is significantly reduced compared to deposition predicted by the AgDRIFT model, especially at distances ≥250 ft (Table 5.4-1). Syngenta recommends the Agency review this study and refine the drift estimates used in the MAGtool and PAT for more accurate estimates of off-field drift contributing to thiamethoxam exposure in the Biological Evaluation.

Table 5.4-1: Calculated deposition of thiamethoxam (lbs ai/A) between 12.5 and 400 ft from edge of spray swath using equations statistically derived from the measured depositions in the spray drift study compared to those predicted by AgDRIFT. (From Table S7 in Perine et al. 2021)							
	Nozzle XR11003	AgDRIFT High boom, very fine to fine	AgDRIFT Low boom, very fine to fine	Nozzle DG11004	Nozzle AIXR11002	AgDRIFT High boom, fine to medium/ coarse	AgDRIFT Low boom, fine to medium/ coarse
Distance (feet)	Increased to 100% (nominal)*	At nominal rate	At nominal rate	Increased to 100% (nominal)*	Increased to 100% (nominal)*	At nominal rate	At nominal rate
12.5	1.37E-03	1.61E-02	5.48E-03	1.39E-03	4.00E-04	2.65E-03	1.57E-03
25	7.30E-04	7.07E-03	2.29E-03	7.25E-04	2.19E-04	1.25E-03	7.40E-04
50	3.30E-04	2.79E-03	9.23E-04	3.19E-04	1.03E-04	5.73E-04	3.42E-04
75	1.90E-04	1.59E-03	5.39E-04	1.79E-04	6.05E-05	3.56E-04	2.14E-04
100	1.22E-04	1.06E-03	3.66E-04	1.13E-04	4.01E-05	2.52E-04	1.52E-04
150	6.05E-05	5.82E-04	2.09E-04	5.43E-05	2.05E-05	1.51E-04	9.35E-05
200	3.47E-05	3.74E-04	1.40E-04	3.03E-05	1.16E-05	1.04E-04	6.50E-05
250	2.14E-05	2.62E-04	1.01E-04	1.87E-05	8.01E-06	7.74E-05	4.90E-05
325	1.16E-05	1.69E-04	6.94E-05	9.79E-06	4.45E-06	5.43E-05	3.47E-05
400	7.12E-06	1.18E-04	5.07E-05	6.23E-06	2.67E-06	4.01E-05	2.67E-05

* Calculations were adjusted to 100% of the nominal application rate (0.086 lbs. ai/A) rather than measured application rates due to lower than expected in-swath sample measurements for a conservative comparison with AgDRIFT deposition estimates.

References

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Brain, R.A., G. Goodwin, F. Abi-Akar, B. Lee, C. Rodgers, B. Flatt, A. Lynn, G. Kruger, D. Perkins. 2019. Winds of change, developing a non-target plant bioassay employing field-based pesticide drift exposure: a case study with atrazine. Sci. Total Environ. 678, 239–252.

Brain, R.A., J. Perine, C. Cooke, C.B. Ellis, P. Harrington, A. Lane, C. O'Sullivan, M. Ledson 2017. Evaluating the effects of herbicide drift on nontarget terrestrial plants: a case study with mesotrione. Environ. Toxicol. Chem. 36 (9), 2465–2475.

Perine, J., J.C. Anderson, G.R. Kruger, F. Abi-Akar, J. Overmyer. 2021. Effect of nozzle selection on deposition of thiamethoxam in Actara® spray drift and implications for off-field risk assessment. Sci. Total Environ. 772 (2021) 144808.

6 Clothianidin Endpoints

The Agency identified both thiamethoxam and its primary degradant clothianidin as residues of concern for terrestrial and aquatic organisms in Chapter 1 of the draft Thiamethoxam BE. To be conservative, the Agency used the lowest effects endpoints from either clothianidin or thiamethoxam studies as input values to the MAGtool, choosing the lowest endpoint for either active ingredient. Considering clothianidin is more toxic to several terrestrial and aquatic taxa, more than half of the values were from clothianidin studies (Table 6.1). Although Syngenta agrees that clothianidin can be considered a degradant of concern, the contribution of clothianidin from a thiamethoxam application for exposure to terrestrial and aquatic wildlife is relatively low, especially at the time of application.

Several studies measuring residues of thiamethoxam and clothianidin in leaves over time following a foliar thiamethoxam application are available (MRID 50425903, 50265504, 50265503, 49804105, 49804101, 50265502) that demonstrate levels of clothianidin are low compared to thiamethoxam (Figure 6.1). Each study had a minimum of three distinct sampling events, with the first sampling taking place immediately after foliar application to the crop. Samples collected on the day of application had the highest thiamethoxam residues; clothianidin was <3% of the initial thiamethoxam residue. As expected, clothianidin concentrations increased after the initial sampling event as thiamethoxam degraded, but quickly decreased alongside thiamethoxam. The majority of the crop's leaf tissue over time contained clothianidin concentrations <25% of thiamethoxam concentrations at each sampling period, except for tomatoes which contained clothianidin concentrations > thiamethoxam. It is important to note that while clothianidin residues increased as thiamethoxam decreased in leaf tissue, these concentrations were never greater than 0.3 mg/kg for any crop.

For bird and mammal assessment purposes, the T-REX model uses the highest estimated exposure concentration compared to the acute and chronic toxicity endpoints for birds and mammals for the active ingredient being assessed. Using the maximum single foliar application rate of 0.266 lbs. a.i./A (turf and ornamentals) and the default DT50 of 3.3 days (see section 5.2), the highest estimated EEC is 63.84 mg/kg diet. Based on the analysis of the leaf residue data (<3% clothianidin formation on day 0), the expected clothianidin concentration would be <1.92 mg/kg diet. Considering the low contribution of clothianidin to the overall exposure of thiamethoxam + clothianidin from a thiamethoxam foliar application, and that foliar application scenarios were determined to be worst-case and used to represent soil and seed treatment uses, there is no justification for using clothianidin endpoints for birds and mammals in the draft Thiamethoxam BE.

Table 6.1. Clothianidin endpoints used as input values in the MAGtool with corresponding thiamethoxam endpoints as replacements.					
Threshold	Taxon	Test Species	Clothianidin Endpoint	Test Species	Thiamethoxam Endpoint
Terrestrial					
Dose Based Mortality (mg ai/kg bw)	Mammals	Mouse (*Mus musculus*)	LD50 = 425	Mouse (*Mus musculus*)	LD50 = 783
	Birds	Japanese quail* (*Coturnix japonica*)	LD50 = 423	Canary (*Serinus canaria*)	LD50 = 431 (slope 5.6)
	Reptiles	Japanese quail* (*Coturnix japonica*)	LD50 = 423	Canary (*Serinus canaria*)	LD50 = 431 (slope 5.6)
Mortality Terrestrial Invertebrates (mg ai/kg soil)	Terrestrial Invertebrates	Earthworm (*Eisenia fetida*)	LC50 = 0.93	Earthworm (*Eisenia fetida*)[1]	LC50 >1000
Dose Based Sublethal Endpoints (mg ai/kg bw)	Mammals	Rat (*Rattus norvegicus*)	MATC = 16	Rat (*Rattus norvegicus*)	MATC = 98.2
	Birds	House Sparrow (*Passer domesticus*)	MATC = 88.7	Mallard (*Anas platyrhynchos*)	MATC =-520
	Reptiles	House Sparrow (*Passer domesticus*)	MATC = 88.7	Mallard (*Anas platyrhynchos*)	MATC =-520
Dietary Based Sublethal Endpoints (mg ai/kg diet)	Birds	Bobwhite quail (*Colinus virginianus*)	MATC = 328	Mallard (*Anas platyrhynchos*)	MATC = 1838.5
Sublethal endpoints Terrestrial Invertebrates: Other units	Terrestrial Invertebrates	Honey bee (*Apis mellifera*)	MATC = 0.0014 mg ai/kg diet	Honey bee (*Apis mellifera*)	MATC = 0.049 mg ai/kg diet
		Springtail (*Folsomia candida*)	MATC = 0.32 mg ai/kg soil	Springtail (*Folsomia candida*)[2]	MATC = 3.3 mg ai/kg soil
		Seven-spotted lady beetle (*Coccinella septempunctata*)	LOAEC = 0.0011 lbs. ai/A		
Aquatic					
Mortality (ug ai/L)	FW Fish	Rainbow trout (*Oncorhynchus mykiss*)	LC50 = >1010500	Blugill Sunfish (*Lepomis machrochirus*)	LC50 >114000
	E/M Fish	Sheepshead minnow (*Cyprinodon variegatus*)	LC50 >91400	Sheepshead minnow (*Cyprinodon variegatus*)	LC50 >111000
	Aquatic Amphibians	Rainbow trout (*Oncorhynchus mykiss*)	LC50 = >1010500	Blugill Sunfish (*Lepomis machrochirus*)	LC50 >114000

	FW Invertebrates	NA	HC05 = 3.58	NA	HC05=11.87
	E/M Invertebrates	Mysid Shrimp (*Mysidopsis bahia*)	LC50 = 51	Mysid Shrimp (*Mysidopsis bahia*)	LC50 = 6900
Sublethal Endpoints (ug ai/L)	FW Fish	Fathead minnow (*Pimephales promelas*)	MATC = 13928	Rainbow trout (*Oncorhynchus mykiss*)	NOAEC = 20000
	FW Invertebrates	Midge (*Chironomus dilutus*)	LOEAC = 0.05	Midge (*Chironomus dilutus*)	LOAEC = 2.23
	E/M Invertebrates	Saltwater mysid shrimp (*Americamysis bahia*)	MATC = 7	Mysid Shrimp (*Mysidopsis bahia*)	MATC = 2793
	Aquatic Plants (non-vascular)	SW diatom (*Skeletonema costatum*)	MATC = 10174	SW diatom (*Skeletonema costatum*)	MATC =68935
	Aquatic Plants (vascular)	Duckweed (*Lemna gibba)*	MATC = 739	Duckweed (*Lemna gibba)*	MATC =31077

* Incorrectly reported as a thiamethoxam study in Table 2-1.

[1] MRID 51485104

[2] MRID 51485102

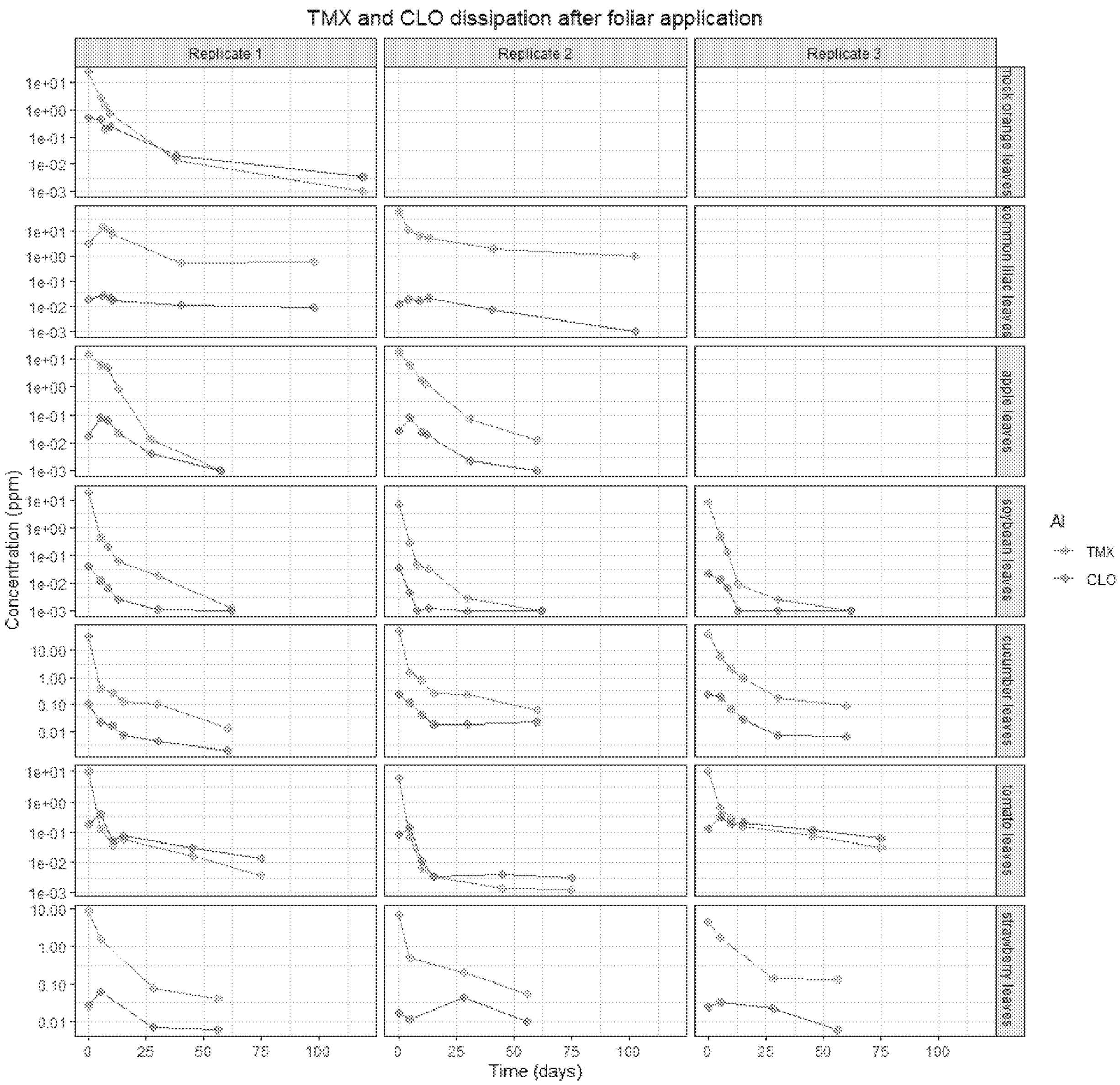

Figure 6-1: Residues of thiamethoxam (TMX) and clothianidin (CLO) in leaf tissue after a foliar application of thiamethoxam.

To determine the contribution of clothianidin to aquatic systems from thiamethoxam applications, data from the 2018 and 2019 Saskatchewan, Canada wetland monitoring program were used (Harrington et al. 2018). All fields surrounding the wetlands were planted with thiamethoxam treated seeds (canola, cereals, or lentils) therefore any detection of clothianidin in the water would have been related to a previous year's clothianidin application or as a result of thiamethoxam degradation entering through runoff. Comparing the concentration of thiamethoxam to clothianidin when the peak concentration of thiamethoxam was detected in the wetland, median clothianidin concentrations were 33% and 27% of thiamethoxam in 2018 and 2019 samples, respectively. Median concentrations detected were low; 0.014

μg/L and 0.007 μg/L for thiamethoxam and clothianidin, respectively, in 2018, and 0.0095 μg/L and 0.002 μg/L, respectively, in 2019.

For assessing chronic exposure, 21 or 28-d rolling averages were calculated based on the timing of the peak thiamethoxam concentration. The percentage of clothianidin compared to thiamethoxam in the median rolling averages was 51% and 64% in 2018 and 2019, respectively. Percentages are higher for the rolling averages, as would be expected considering the longer thiamethoxam remains in the soil, the more clothianidin is formed and less thiamethoxam is present. In addition, thiamethoxam is more water soluble and therefore would be expected to move more quickly in runoff than clothianidin. Although the percentages of clothianidin in the rolling averages is higher than at the peak detection of thiamethoxam, concentrations are also lower; median 21-d concentrations were 0.006 μg/L and 0.003 μg/L for thiamethoxam and clothianidin, respectively, in 2018 and 0.005 μg/L and 0.003 μg/L, respectively, in 2019 (Attachment - TK0384563_Prairie wetlands 2019_ Supplementary report.xlsx.

A study conducted in Missouri in 2021 corroborates the findings from the Canada studies. Daily composite samples from a farm pond receiving runoff from a watershed planted with thiamethoxam treated soybeans were analyzed for thiamethoxam and clothianidin (see section 5.1.4 for additional information). Concentrations of clothianidin were higher than thiamethoxam in samples collected prior to 2021 soybean planting due to clothianidin treated corn planted in the fields in 2020. After 2021 soybean planting, rainfall events leading to runoff resulted in higher concentrations of thiamethoxam being detected; clothianidin was approximately 20% of the thiamethoxam concentration. The range of thiamethoxam concentrations was from 2 μg/L to <LOQ; clothianidin ranged from 0.4 to 0.035 μg/L. (Data included in Appendix 3.2).

As with the residues on foliage, concentrations of clothianidin from thiamethoxam applications in aquatic systems are <50% of the thiamethoxam concentration detected at peak levels and therefore are not a majority of the residue of concern to warrant using clothianidin effects endpoints in the draft Thiamethoxam BE. Syngenta recommends that thiamethoxam endpoints be used as the primary input values into the MAGtool for all taxa and that clothianidin endpoints serve as alternatives.

7 Direct Effects Refinements

7.1 Species Sensitivity Distribution (SSD) for Aquatic Invertebrates Outside the Class Insecta

As stated in Chapter 2, Section 6.1, in the draft Thiamethoxam BE, "The available data indicate that thiamethoxam is more toxic to insects compared to other species of aquatic invertebrates (e.g., *Daphnia* sp., mollusks). Therefore, in the BE, separate thresholds are used for direct toxicity to listed insects, mollusks and other species of aquatic invertebrates." The Agency rightfully assessed mollusks separately, using taxa-specific data in the MAGtool to determine that there were no direct or indirect effects (i.e. No Effects) to listed mollusks, however there was no additional separation of other aquatic invertebrates outside the class Insecta from sensitive aquatic insects and therefore all listed species, other than mollusks, were assessed using the aquatic insect SSD HC05. In addition, an extra layer of conservatism was added by using the clothianidin HC05 (3.58 μg/L) (see section 6.0 for Syngenta's position on the use of clothianidin endpoints).

Excluding mollusks, the remainder of listed aquatic invertebrates are primarily outside the class Insecta (i.e. crayfish, shrimp, amphipods, isopods). Sufficient toxicity data (i.e. LC or EC50 values) are available from registrant submitted studies and the open literature to generate a thiamethoxam aquatic invertebrate

SSD for invertebrates outside the class Insecta to estimate an HC05 that could be used as an input value for the MAGtool.

Acute toxicity data for 11 aquatic invertebrate species outside the class Insecta exposed to thiamethoxam are listed in Table 7.1-1. Data used to derive the SSDs are from open literature studies, as well as unpublished registrant submitted studies and were recently utilized as part of an aquatic invertebrate SSD by the Pest Management Regulatory Authority (PMRA) in their recent special review of thiamethoxam (PMRA, 2018; PMRA 2021). All endpoints were EC/LC$_{50}$ values where definitive mortality or immobility endpoints from 48 or 96-hour studies. Endpoints without definitive endpoints were not used unless there was no similar taxonomic species available.

Table 7.1-1. Invertebrate species, study duration, EC/LC50 and 95% confidence intervals following acute exposure to thiamethoxam

Invertebrate species	Study Duration (Hours)	EC/LC$_{50}$ (µg/L)		95% CI (µg/L)	Reference
Asellus aquaticus	48	84		44 - 160	MRID 51485105
Cyprididae sp.	48	180		150-220	MRID 51485106
Hyalella azteca	96	391		312.1 - 469.9	ECOTOX 178290
Crangonyx pseudogracilis	48	420	Geomean: 651.3	200-870	MRID 51485105
	48	1010		310 - 3350	MRID 51485103
Lampsilis fasciola	96	691		--	ECOTOX 173464
Procambarus clarkii	96	2310	Geomean: 1494.6	1630 – 3280	MRID 47558106
	96	967		879 – 1045	ECOTOX 120043
Lumbriculus variegatus.	96	2035.1		1700 - 2370	ECOTOX 178290
Gammarus sp.	48	2800		1700 - 4100	MRID 51485107
Gammarus kischineffensis	96	3751		3506 - 8332	ECOTOX 173084
Caecidotea sp.	96	4775.4		2976.3-6574.6	ECOTOX 178290
Lumbriculus sp.	48	7700		--	MRID 51485105

An acute SSD was derived using the SSD Toolbox Version 1.0 from the U.S. EPA (Etterson, 2020a,b) and the dataset shown in Table 7.1-1. All distributions had an adequate goodness-of-fit ($p < 0.05$) for parametric bootstrap goodness-of-fit (GOF) test (Table 7.1-2), with p-values in the range of 0.32 to 0.66. HC05 values for these distributions ranged from 76.9 to 123.0 µg a.i./L. Four distributions had the similarly low AICc scores and therefore contributed significantly (>10%) and relatively equally to the weighted HC05. The remaining two distributions were still included to ensure the robustness of the HC05. The combined weighted HC05 value was 106.1 µg a.i./L (36.8 – 458.7 µg a.i./L). The results of all distributions can be found in Table 7.1-2 and Figure 7.1-1. The decision to utilize a weighted average HC05 that included all distributions was based on a combination of evidence including the p-values from the goodness-of fit tests, the AIC_c scores and corresponding weight and the confidence limits for the various distributions along with a visual inspection of the data.

Table 7.1-2. Summary of species sensitivity distribution results for acute invertebrate toxicity from thiamethoxam. All concentrations are reported as µg a.i./L.

Distribution	p from GOF Test	AICc	Delta AICc	Weight	HC05	95% LCL	95% UCL	Wtd. HC05	Wtd. LCL	Wtd. UCL
Log-triangular	0.60	197.0	0.08	0.28	120.7	63.03	434.5	34.10	17.81	122.80
Log-normal	0.47	197.7	0.76	0.20	119.1	38.85	469.0	23.93	7.80	94.22
Log-Gumbel	0.66	199.9	2.99	0.07	123.0	61.17	394.2	8.09	4.02	25.94
Burr III	0.46	202.4	5.53	0.02	107.3	25.38	522.4	1.99	0.47	9.66
Log-logistic	0.32	198.4	1.51	0.14	111.4	24.70	498.6	15.42	3.42	69.01
Weibull	0.48	196.9	0.00	0.29	76.9	11.26	466.5	22.60	3.31	137.04
							Weighted HC05	**106.1**	**36.8**	**458.7**

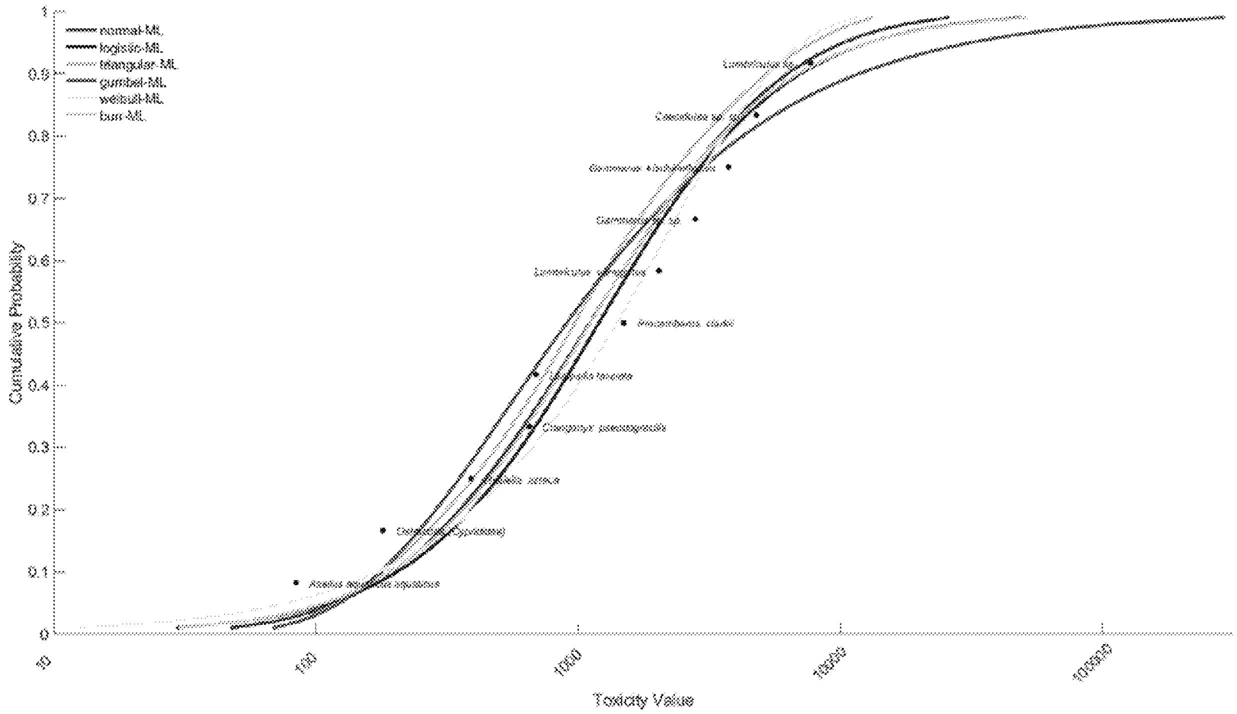

Figure 7.1-1. Six distributions fit for acute toxicity of 11 aquatic invertebrate species outside the class Insecta exposed to thiamethoxam. The dataset in Table 6-1 was used for this analysis.

Comparing the HC05 of 106.1 µg/L with daily 1 in 15 maximum values for aquatic invertebrates in Appendix 4-2 of the draft Thiamethoxam BE, all of the scenarios that estimate concentrations ≥ 106.1 µg/L were from Bins 2 and 5. The Agency states in Chapter 3, section 3.1 of the draft Thiamethoxam BE, that "bins 2 and 5 are very small waterbodies and the EECs in them would be reflective of concentrations in a headwater stream or a standing puddle that received runoff at the edge of a treated field." This is overly conservative and does not reflect measured concentrations observed in monitoring data referenced previously in Section 5 of this document and those listed in Appendix 3-3 in the draft Thiamethoxam BE, with the exception of 1 sample from a playa lake in the Southern High Plains of Texas (Floyd and Briscoe Counties) where the maximum concentration was 225 µg/L (Anderson et al. 2013); however, the mean and median values from 108 samples collected in the playas was 3.6 and 0.1 (used to represent no detection for statistical calculations) µg/L, respectively, indicating the high detection is likely an outlier and may have come from a compromised sample.

As described previously in Section 5, additional thiamethoxam monitoring data are available from samples collected as part of wetland monitoring program in Saskatchewan, Canada over two consecutive years (2018 and 2019), two streams in watersheds highly vulnerable to runoff that are part of the Atrazine Ecological Monitoring Program (AEMP) in the Midwest US (NE-04 and MO-08) where thiamethoxam is widely used and two waterways in Ontario, Canada (Horner Creek and Nith River) from 2021 (Table 7.1-3). Data from daily or weekly samples over the growing season demonstrate low levels of thiamethoxam with maximum concentrations below 2 µg/L.

Table 7.1-3. Summary statistics for thiamethoxam concentrations detected in water monitoring programs not included in Appendix 3-3 in the Thiamethoxam BE.						
Site	Year	Sample Frequency	Average (µg/L)	50th percentile (µg/L)	90th percentile (µg/L)	Maximum (µg/L)
MO-08	2021	Daily	0.064	0.047	0.151	0.415
NE-04	2021	Daily	0.031	0.011	0.090	0.278
Horner Creek	2021	Daily	0.008	0.004	0.021	0.072
Nith River	2021	Daily	0.011	0.004	0.030	0.099
Canada Wetlands	2018	Weekly	0.065	0.014	0.117	1.850
Canada Wetlands	2019	Weekly	0.023	0.010	0.039	0.270

There are no sublethal endpoints from studies conducted with aquatic invertebrates outside the class Insecta that suggest any concern at environmentally realistic and maximum modeled values. As stated in Chapter 2, section 6.3 of the draft Thiamethoxam BE, the most sensitive growth and reproduction endpoint for aquatic invertebrates outside the class Insecta was based on a 16% decrease in the number of offspring in *D. magna* (NOAEC = 50,000 µg/L).

Based on the information provided, Syngenta believes that adverse effects to listed aquatic invertebrates outside the class Insecta are not likely to occur and requests that the Agency re-evaluates how these species are assessed in the MAGtool with consideration of the HC05 for aquatic invertebrates outside the Class Insecta and exposure concentrations more reflective of those observed in available monitoring data.

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PMRA. 2021. Special Review Decision: Clothianidin Risk to Aquatic Invertebrates: Final Decision Document, SRD2021-03. Pest Management Regulatory Agency, Ottawa, Ontario.

7.2 Taxa Specific Sensitivity

The Agency acknowledged that mollusks are not sensitive to thiamethoxam and used the EC50 from the shell deposition study with the Easter Oyster as the endpoint in the MAGtool rather than relying on the lowest EC50 values for aquatic invertebrates or the HC05 value from the aquatic insect SSD. Syngenta agrees that the Agency should look to use toxicity endpoints from closely related species when available rather than resorting to the most sensitive endpoint from species that are evolutionally more distinct, as more closely related species are more likely to have similar physiology and responses to chemical exposure. This is particularly important for thiamethoxam, which is highly specific for the insect nicotinic acetylcholine receptors, resulting in lower toxicity to taxa outside the Class Insecta.

Syngenta believes that addition taxa could have been assessed separately as were mollusks in the draft Thiamethoxam BE. An acute toxicity study with the red swamp crayfish, *Procambarus clarkii*, resulted in a 96-hr LC50 value of 967 µg a.i./L (E120043). This endpoint could have been used as a surrogate to represent all the listed crayfish instead of using the clothianidin HC05 value of 3.58 µg a.i./L. Compared to EECs outside of bins 2 and 5, which are unrealistic, and available monitoring data, a No Effect determination could have been made for all listed crayfish in Step 1.

Lepidopterans could also have been assessed separately. Thiamethoxam has low efficacy towards Lepidopterans and therefore Lepidopteran pest species are not listed as target pests on the solo thiamethoxam product label (Actara®). Studies by Krishnan et al. (2020; 2021) assessed the toxicity of thiamethoxam to various life-stages of the monarch butterfly, *Danaus plexippus*. Monarch eggs and larvae were determined to be more sensitive than pupae and adults (Krishnan et al. 2021). The lowest contact and dietary LD50 values were for larvae; 6.1 mg/kg bw and 3.5 mg a.i./kg diet, respectively. These values are over two orders of magnitude higher than the Asiatic honey bee, *Apis ceranae*, contact LOAEC of 0.032 mg a.i.kg bw and the European honey bee, *Apis mellifera*, dietary LC50 of 0.014 mg a.i./kg diet used in the MAGtool. It is uncertain how use of the monarch endpoints would influence the output of the MAGtool for listed Lepidopteran species, however Syngenta recommends further consideration of the data from the Krishnan et al. (2020; 2021) studies to refine the assessment for listed Lepidopterans.

References

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8 Indirect Effects Assessment

8.1 Consideration of the Habitats Required by Listed Species and the Proximity of Those Habitats to Thiamethoxam Use Patterns

Many listed species have habitat requirements (landscape features and unique life history elements) that are not conducive to growing crops or other uses for which thiamethoxam may be applied (e.g., field nurseries, soil amendments with poultry litter). As a result, the ranges of such species are not sufficiently proximal to thiamethoxam crop and other use pattern footprints to result in exposure. For example, the Alameda whipsnake (AWS) inhabits local variations of chaparral, which have low nutrient levels and range from deep, weakly developed soils to shallow, rocky soils (FWS, 2021a). Temperatures in AWS habitats often exceed 100°F. The salt marsh harvest mouse (SMHM) is endemic to the emergent wetlands of San Francisco Bay and its tributaries (Bias and Morrison, 1999) and is generally restricted to saline or brackish marsh habitats around the San Francisco Bay Estuary. The fragrant prickly-apple (FPA) is a cactus species only found in sand pine scrub habitat and in xeric hammock, coastal strand, and coastal hammocks along the Atlantic Coastal Ridge (FWS, 2021a). For each of these listed species, however, in the draft Thiamethoxam BE, the Agency assumed that their dietary items (for the AWS and SMHM) or pollinators (for the FPA) were present on treated fields and other treated areas during thiamethoxam applications. However, based on proximity analyses for the agricultural use patterns deemed LAA in the draft BE for indirect effects to these three listed species, none were found in close proximity to the species ranges. In fact, most were at distances beyond which the EPA assumes zero spray drift even for aerial applications of thiamethoxam. The Agency provided no scientific rationale in the draft BE for their assumption that dietary items or pollinators of listed species would be present on treated fields even though the habitat requirements of these receptor groups are generally similar to those where the listed species are found (e.g., the major dietary items of the SMHM are saltgrass and pickerel weed which also require brackish marsh habitats). Had the Agency accounted for proximity of thiamethoxam use patterns to the habitats where listed species are found and adjusted exposure accordingly using a spray drift model, many LAA conclusions for indirect effects would have been NLAA. This was our finding for the AWS, SMHM and FPA.

8.2 Consideration of Unique Diets of Listed Species

The MAGtool is an automated tool designed to automate and improve the efficiency of the difficult task of assessing over 1800 listed species and over 800 critical habitats for a wide variety of use patterns, application methods and formulations. However, there is a major drawback to use of an automated tool, i.e., the model fails to consider critical species-specific foraging behaviors, diets and habitats, many of which are highly specialized. For example, the AWS has a near obligate dependency on western fence lizards for its diet (FWS, 2021a). The current implementation of the MAGtool, however, only considers terrestrial insects in estimating the effects of pesticides, including thiamethoxam, to the prey of the AWS. Terrestrial insects are infrequently consumed by this species and the EPA (2021) provided no evidence that reduced availability of insect prey would have any impact on even one individual AWS. The AWS case study provides additional details on this issue (See Appendix 4).

As with the AWS, the issue of focusing on an inconsequential dietary item played out for other terrestrial wildlife species, e.g., the SMHM (See Appendix 4 for additional information). In the case of the Everglade snail kite (ESK), the model correctly considered aquatic invertebrates as the major receptor group upon which the kite species depends for food. However, the ESK has an obligate dependency on apple snails (Reichert et al., 2020), a unique dietary requirement that was not considered in the draft BE (see Appendix 4). Although thiamethoxam is toxic to aquatic insects, it is non-toxic to aquatic snails including apple snails even at the upper bound concentrations estimated to occur by the EPA in habitats of the Everglade snail kite (see Figure 8.2-1).

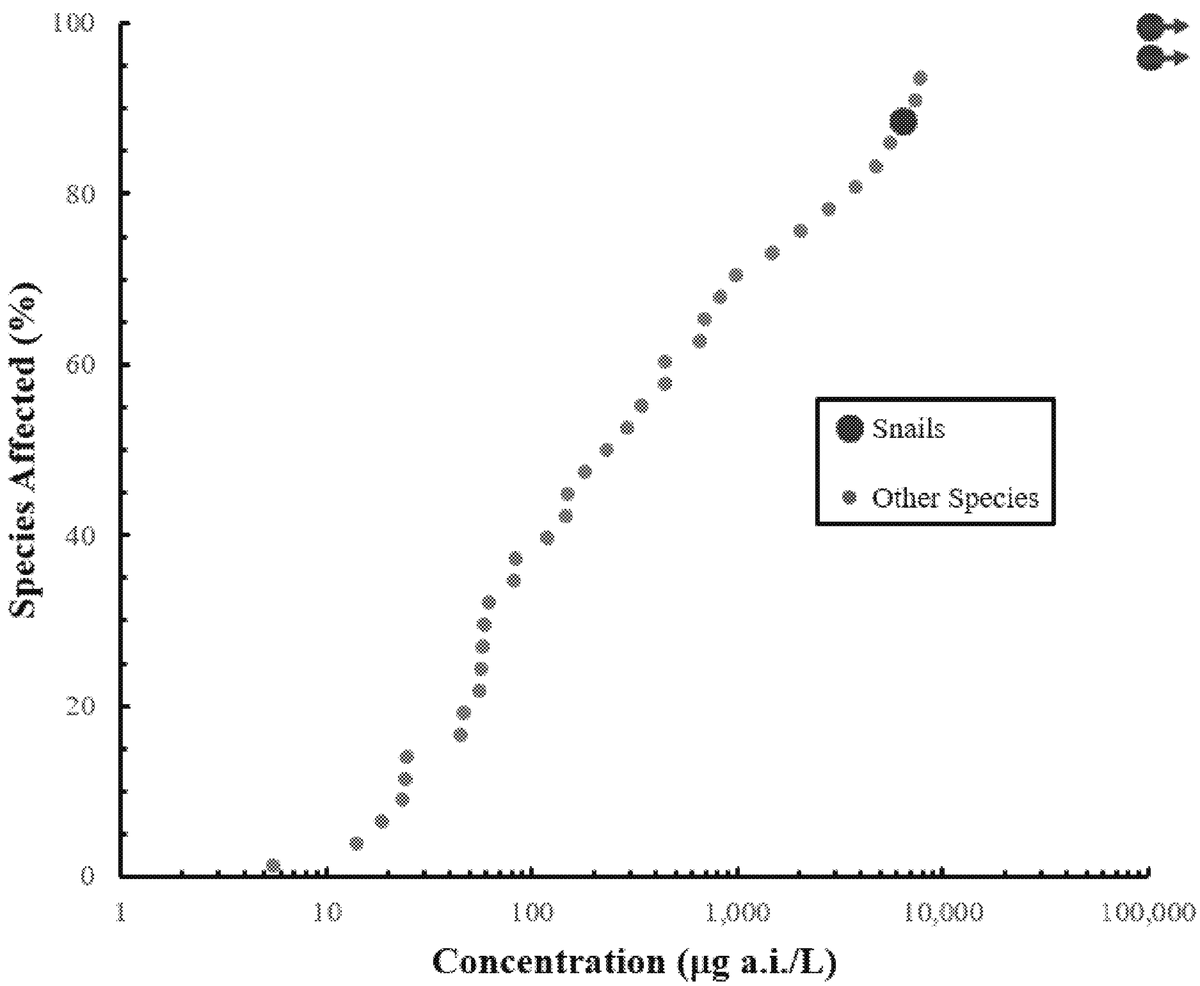

Figure 8.2-1. Acute species sensitivity distribution for aquatic invertebrate species exposed to thiamethoxam. Data from the PMRA (2018) and Miles et al. (2017). Arrows indicate unbounded EC/LC50s.

The lack of species specificity regarding the dietary requirements of listed species led to the EPA concluding that use of thiamethoxam would adversely affect the availability of prey upon which listed species depend for numerous use patterns. Had the unique dietary requirements of listed animal species been considered, there likely would have been significantly fewer Likely to Adversely Affect conclusions. We recommend that the EPA modify the MAGtool to estimate exposure and risk to the major dietary items upon which each listed species depends, rather than focusing on worst-case or "easiest to model" minor dietary items. We further recommend that the EPA model typical diets for listed species that have multiple dietary items rather than modeling each dietary item assuming that it constitutes 100% of the diet.

8.3 Consideration of Other Relevant Lines of Evidence

The EPA documented in the draft BE the uncertainties associated with using the Pesticide Water Calculator (PWC) (which provides inputs to the MAGtool) to model static water bodies systems. The PWC assumes that such systems have no outlet, resulting in the accumulation of pesticide over time. Increases in water body volume that occur following runoff events are not included in the model. Thus, modeled EECs for thiamethoxam are over-predictions for static water bodies. For flowing water bodies, the PWC assumes a constant volume and flow, thus changes in pesticide concentrations arising from changes in flow rate are not modeled. Ideally, a watershed-based model (e.g., Surface Water Assessment Tool (SWAT)) should be applied to predict flowing water concentrations. These models can account for flow and volume fluctuations as well as predict concentrations within a watershed that has multiple source inputs. Watersheds (several orders of magnitude larger in size than the Index Reservoir), have substantial heterogeneity in runoff and transport processes, variability in pesticide usage (amounts, application practices, and application timing), and exhibit dampening and dispersion in chemograph peaks associated with variable travel times and attenuation. These factors are not accounted for in the Index Reservoir conceptual model that was applied in the draft Thiamethoxam BE. Overall, both static and flowing water thiamethoxam EECs are uncertain and likely overestimated.

Although the Agency documented available monitoring data in the draft Thiamethoxam BE, the data were not used to evaluate model performance, nor were the data used in making NLAA/LAA decisions for indirect effects to listed species. As demonstrated in our case studies for the ESK and the sharpnose shiner (SNS) (see Appendix 4), the available monitoring data in the habitats and regions where the species are found were below the detection limit or orders of magnitude below the EPA's estimated environmental concentrations (EECs). Higher tier mesocosm studies are also available for thiamethoxam but were not considered as lines of evidence in the draft BE. The most relevant study by Finnegan et al. (2018) was an outdoor mesocosm study that included primary producers, zooplankton and macroinvertebrates (see Appendix 4 for details). The authors determined a No Observed Ecological Adverse Effect Concentration (NOEAEC) of 30 mg a.i./L. The NOEAEC is above the EPA's estimated 1-in-15 year concentrations for thiamethoxam in habitats of the ESK and SNS for all use patterns for which the EPA derived a Likely to Adversely Affect conclusion for indirect effects. This result occurred even though the mesocosm study included insect taxa known to be sensitive to thiamethoxam (e.g., Chironomidae and *Notonecta* sp.) (Finnegan et al., 2017, 2018). The NOEAEC is also orders of magnitude above the highest thiamethoxam concentrations detected in the regions and habitat types where the ESK and SNS are found.

The Pest Management Regulatory Agency (PMRA) in their Special Review of thiamethoxam (PMRA, 2021) used water monitoring data (along with its ancillary information) and a mesocosm-based effects metric in estimating risks to aquatic invertebrates. We recommend that the EPA incorporate other lines of evidence (i.e., monitoring data, mesocosm studies) in their decision making for listed species potentially exposed to thiamethoxam.

8.4 Use of Clothianidin Effects Metrics

As stated in Section 6, the Agency identified both parent thiamethoxam and its degradant clothianidin as residues of concern for terrestrial and aquatic organisms in the draft Thiamethoxam BE. To be conservative, the Agency used the most sensitive effects endpoint between clothianidin and thiamethoxam for each receptor group being assessed. Although clothianidin is more toxic to some terrestrial and aquatic receptor groups, the contribution of clothianidin from a thiamethoxam application for exposure to terrestrial and aquatic wildlife is relatively low (MRID 50425903, 50265504, 50265503, 49804105, 49804101, 50265502 for foliage studies; Harrington et al. 2018 for wetlands). This is particularly true at the time of application which is the basis for the nomograms used to estimate risk to terrestrial biota upon which listed species depend for prey, pollination services, and biological dispersal. Therefore, the Agency should have relied on thiamethoxam, not clothianidin, effects metrics for assessing indirect effects.

8.5 Conservativeness of PPHD Assessments

Compounding conservatism in the draft Thiamethoxam BE is a significant concern and likely the most important reason for many of the Likely to Adversely Affect decisions for indirect effects to listed species. For example, the spatial data describing where the listed species ranges and critical habitats are located are imprecise and highly conservative (e.g., county level in most cases).

The assumption that state-level usage data occurs within each species range (until all potential acres have been treated at the maximum permitted application rate and number of applications) is one of many overly conservative assumptions with regard to incorporating usage data to estimate exposure, particularly for listed species with small ranges. Although the EPA investigated more realistic assumptions regarding the spatial distribution of usage data for thiamethoxam, the more realistic analyses were only used in determining confidence in each LAA determination derived using the worst-case assumptions for usage data. Where no usage was reported, or where percent crop treated (PCT), in the summary use and usage matrix (SUUM) (Appendix 1-4, Table 2 of the draft BE) was reported as "< 1%" or "< 2.5%", then the PCT was assumed to be 2.5% for that use pattern and state. This ultimately rolled up to the state-level PCTs for the associated UDL being set to 2.5% in the MAGtool inputs. Setting PCTs to be a minimum of 2.5% results in excessive overestimation of usage for some crops, particularly large acreage crops. The assumption of a minimum PCT of 2.5% is too high, as it results in unrealistic usage estimates that are not supported by best available datasets. A lower minimum of 1% or 0.5% would be more appropriate in cases where the available PCT indicates <1% or no usage, especially for larger acreage crops where seemingly small PCT values can lead to substantial amounts of thiamethoxam being assumed to enter the environment.

For terrestrial listed species, off-field drift estimates did not account for the habitats where listed species and the biota on which they depend for PPHD may be found. The EPA's spray drift model (i.e., AgDrift) provides upper bound estimates of drift based on data collected for drift over bare ground areas. Thus, spray drift interception, for example, vegetative filter strips, are not accounted for. Previously, the EPA considered spray drift interception and direction as a qualitative line of evidence supporting their conclusion that pinnipeds basking on beaches are not likely to be adversely affected by atrazine use (EPA, 2020b).

In the absence of data (e.g., toxicity tests for listed species) or in the presence of naturally variable data such as weather, risk assessments should be performed using reasonable and conservative assumptions that account for uncertainty. Compounding conservative assumptions at all steps in the exposure, effects and risk analyses, to give the 'benefit of doubt' to the listed species, leads to completely unrealistic risk estimates. Combining unrealistic exposure and risk estimates with a protection goal that is extremely conservative (e.g., one individual out of an estimated species population), results in nearly every species not screened out in Step 1 receiving a MA/LAA effect determination. This was indeed the case in the thiamethoxam BE, particularly for indirect effects to listed species. Despite the Agency's efforts to automate the BE process to gain efficiency, this has been done at the expense of refinement and accuracy, leading to more species moving to Step 3 than necessary. Consequently, the majority of individual species considerations will need to be addressed by the Services.

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9 Utilization of Conservation Measures and Stewardship Practices for Avoidance, Minimization and Mitigation

As outlined in the "Neonicotinoid Pesticide Draft Biological Evaluation Frequently Asked Questions", "*EPA is considering additional mitigation measures, which may inform the final biological evaluation or the biological opinions. If the Services identify additional mitigation measures as part of formal consultation, they will include them in the biological opinions. Some of those measures may be tailored to the conservation needs of individual species, based on future discussions among EPA, the Services, and pesticide registrants.*"

In Chapter 3 of the draft Thiamethoxam BE, the aquatic modeling was deemed to be extremely conservative with the assumption that water bodies are abutting the treated areas without consideration of buffers. As this assumption does not reflect drift mitigation, buffers and other practices including nozzle types and droplet size, it is important that these types of mitigations are considered during Step 3 and the jeopardy decisions. There are many conservation measures and stewardship practices that can be used to mitigate the potential negative effects to listed species and critical habitats. The table below lists current practices utilized by farmers and applicators as well as refinement tools which should all be taken into consideration conservation measures of avoidance, minimization, and mitigation.

Table 9-1. Conservation Measures – Avoidance, Minimization, Mitigation

Conservation Measure Type	Practices - Examples
Product Labels	**Buffers, Nozzle Types, Droplet Size, Drift Mitigation**
Application Timing	**Specific Crop, Pest and Region Considerations**
Equipment	**Nozzles, Hooded Sprayers, Drift Reduction, Dust Reduction**
Stewardship Practices	**BeSure!, Best Management Practices, Integrated Pest Management**
Conservation Offsets	**Current and Future Programs – Habitat Restoration**
Refinement Tools	**Species Sequencing, Refined Range Mapping, Probabilistic Models**

Farmers use many practices to ensure that pesticides stay at the site of application while avoiding and/or minimizing harm to non-target organisms. The current thiamethoxam labels have information for mitigating off-target movement and/or exposure to non-target organisms. Specific label language depends on the type of application method such as seed treatment, soil application and foliar application which may have different mitigating practices. Seed treatment labels have language advising toxicity to bees and outlines practices for covering or collecting seeds that are spilled during loading, so it does not cause harm to wildlife. In some cases, there is information to protect a threatened species such as the Preble's Meadow Jumping Mouse with restrictions on planting sunflower seeds treated with thiamethoxam in Elbert or Weld Counties in Colorado. Soil and foliar applied thiamethoxam products have language for mitigating effects to pollinators as well as specific information relative to nozzle types, droplet size, buffers, and drift mitigation. As part of the registration review process, EPA has proposed additional label mitigation measures in the Proposed Interim Decision which will be adopted by neonicotinoid registrants after the Interim Decision is released in late 2022.

9.1 Summary - Current and Proposed Interim Decision (PID) Label Mitigations – Thiamethoxam Soil and Foliar Applied Product Labels

1. <u>Mitigation Type – Buffers: Aquatic Areas</u>

Current Soil Application Label - A level, well-maintained buffer strip between areas to which this product is applied and surface features such as ponds, streams, and springs will reduce the potential loading of thiamethoxam water from runoff water and sediment.

Current Foliar Application Label - A level, well-maintained buffer strip between areas to which this product is applied and surface features such as ponds, streams, and springs will reduce the potential loading of thiamethoxam water from runoff water and sediment. Do not cultivate or plant crops within 25 feet of the aquatic area as to allow growth of a vegetative filter strip.

PID Proposals - Do not apply by ground within 25 feet, or by air within 150 feet of lakes, reservoirs, rivers, permanent streams, marshes or natural ponds, estuaries, and commercial fish farm ponds. Only apply products containing thiamethoxam onto fields where a maintained vegetative filter strip of at least 10 feet exists between the field edge and where a down gradient aquatic habitat exists. Western irrigated agriculture is exempt from this requirement. Western irrigated agriculture is defined as irrigated farmland in the following states: WA, OR, CA, ID, NV, UT, AZ, MT, WY, CO, NM, and TX (west of I-35).

2. <u>Mitigation Type – Nozzle Type</u>

Current Soil Application Label - Select spray nozzles which will provide accurate and uniform spray deposition.

Current Foliar Application Label - Use spray nozzles which produce medium-sized droplets and reduce drift.

PID Proposals - Advisory: Use a spray nozzle that is designed for the intended application. Consider using nozzles designed to reduce drift.

3. <u>Mitigation Type – Droplet Size</u>

Current Soil Application Label – Not Applicable

Current Foliar Application Label - Use the largest droplet size consistent with good pest control. Small droplets are more prone to spray drift and can be minimized by appropriate nozzle selection, by orienting nozzles away from the air stream as much as possible, and by avoiding excessive spray boom pressure. For ground application, when using water volumes of 5-10 gallons, fine-sized droplets may be used to improve spray coverage.

PID Proposals - Applicators are required to use a medium or coarser (ASABE S572.1) droplet size. Advisory: When making applications in hot and dry conditions, use larger droplets to reduce effects of evaporation.

4. <u>Mitigation Type – Drift Mitigation</u>

Current Soil Application Label – Do not allow this product to drift. Do not apply with aerial equipment.

Current Foliar Application Label - Current: Make applications when wind velocity favors on-target product deposition (approximately 3-10 miles per hour). Do not apply when wind velocity exceeds 10 miles per hour. Do not make applications when wind gusts approach 10 miles per hour. To reduce the risk of exposure to sensitive aquatic areas, do not make applications when wind direction is toward the aquatic area. Do not make applications during temperature inversions. Do not make applications more than 10 feet above the crop canopy. For aerial applications, mount the spray boom on the aircraft to minimize drift caused by wing tip vortices. The minimum practical boom length should be used and must not exceed 75% of the wingspan or rotor diameter.

PID Proposals:

All Applications: Applicators are required to use a medium or coarser droplet size (ASABE S572.1). Do not apply when wind speeds exceed 15 miles per hour at the application site. Do not apply during temperature inversions.

Aerial Applications: Do not release spray at a height greater than 10 feet above the ground or vegetative canopy, unless a greater application height is necessary for If the windspeed is greater than 10 miles per hour, the boom length must be 65% or less of the wingspan for fixed wing aircraft and 75% or less of the rotor diameter for helicopters. Otherwise, the boom length must be 75% or less of the wingspan for fixed-wing aircraft and 90% or less of the rotor diameter for helicopters. For aerial applicators, if the windspeed is 10 miles per hour or less, applicators must use ½ swath displacement upwind at the downwind edge of the field. When the windspeed is between 11-15 miles per hour, applicators must use ¾ swath displacement upwind at the downwind edge of the field.

Airblast applications: Sprays must be directed into the canopy. User must turn off outward pointing nozzles at row ends and when spraying outer row.

Ground Boom Applications: User must only apply with the release height recommended by the manufacturer, but no more than 4 feet above the ground or crop canopy.

9.1.1 Stewardship Practices – Growing Matters Coalition

The Growing Matters Coalition (www.growingmatters.org) is an alliance of organizations and individuals committed to scientific discourse on the stewardship, benefits, and alternatives of neonicotinoid insecticides in North America. Bayer CropScience, Syngenta, Valent U.S.A. LLC, BASF Agricultural Solutions and Mitsui Chemicals Agro, Inc. are leading this coalition. In 2013, the companies jointly commissioned a comprehensive evaluation of the economic and societal benefits of neonicotinoid insecticides to North American agriculture, as well trees, turf and landscape and production ornamentals. AgInfomatics, LLC, an independent agricultural consulting firm established in 1995 by professors from the University of Wisconsin-Madison and Washington State University was commissioned to conduct research and published a series of reports and resource materials.

Protecting bees and other wildlife is a major part of good stewardship practices and is why Growing Matters launched BeSure! to support farmers and applicators in accomplishing this protection goal. The BeSure! program (https://growingmatters.org/besure) started in 2019 and continues today. The BeSure! program informs farmers, pesticide applicators and other pesticide users about pollinator stewardship practices while utilizing effective pest control practices. Deciding how to manage weeds, insects and diseases that routinely attack crops and landscapes is just one of many decisions farmers and applicators must make each season. When choosing crop protection tools, both effectiveness and potential impact on the environment must be considered.

The BeSure! program information is delivered from the initiation of the planting season through the key foliar applications during the growing season. The BeSure! messages are delivered across a number of different communication platforms such as digital ads, print media, radio segments, shareable content, social media, and trade shows. By utilizing a variety of media platforms, the BeSure! messages reach a large audience and reinforces practical stewardship practices that protect pollinators and other wildlife when handling, planting, and disposing of treated seeds, as well as from other product applications used throughout the growing season, including a broad range of crops, turf, ornamental plants, and trees.

As we look to the future, the messaging on proper use of pesticides and best management practices also would have benefits for avoiding, minimizing, and mitigating risks to listed species and their critical habitats. This significant stewardship program should be considered as part of the Step 3 consultation with the Services.

9.1.2 Conservation Offsets

Syngenta recognizes the importance of having conservation offsets to restore listed species populations and their critical habitats. As discussions move forward regarding where reasonable and prudent measures and reasonable and prudent alternatives are needed, conservation offsets already in place and opportunities for new offsets need to be part of the discussion. For the last five years, Syngenta has worked on a number of pilot net-conservation benefits projects for various species including fish, freshwater mussels, insects, and plants across three distinct geographic regions located in California, Iowa and Mississippi. A paper with the program will be submitted as a separate document and the paper's executive summary is listed as follows:

Executive Summary – "Developing a net-conservation benefit approach to pesticide consultations under the Endangered Species Act"

A net-conservation benefit approach is proposed for threatened and endangered species that will enable simplifying consultations for Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) pesticide actions under section 7 of the Endangered Species Act (ESA). The goal is to develop an optional approach that applies net conservation benefit measures to species that have been assessed to have potential, modeled or uncertain effects from a pesticide. This voluntary program was designed to reduce regulatory complexity by completing endangered species consultations for those covered species in a more timely and predictable manner to achieve several important goals:

- pesticides are approved through an efficient process as expeditiously as possible,
- approved uses comply with federal laws, including ESA consultation requirements,
- federal agencies maximize the number of pesticides they evaluate with their limited resources, new science-based conservation programs promote net benefits for species and their habitats.

This program has two distinct but related parts. The first involves selecting a few agricultural sites to test and demonstrate conservation programs that can offset modeled or uncertain effects from a pesticide on ESA listed species. The conservation measures used will be informed by U.S. Fish and Wildlife Services or National Marine Fisheries Service documents, such as listing decisions, Species Status Assessments, 5-year status reviews, recovery plans, existing Biological Opinions, and Safe Harbor Agreements, as well as peer reviewed published literature and species biology experts. The conservation measures will be performed by local third-party experts from conservation groups that are already in place and have the knowledge and network to enact the practices. Syngenta will offer partial financial and technical support for these activities, and additional funding through USDA, FWS, and other grant sources will be sought for these projects, using the Syngenta funding to help secure such grants. Data will be collected to monitor the efficacy of conservation measures. Outcomes of the conservation measures will be documented to inform the second part of our project.

The second part of the program will develop and demonstrate how pesticide consultations can be streamlined using the conservation measures from the first part. For our pilot project, we will not use an actual pesticide consultation but instead demonstrate a framework using hypothetical or mock consultation(s) to show how conservation benefits can be incorporated into the consultation process and outcomes. Soon, the piloted framework could be applied to an actual consultation and scaled to a national or programmatic level. The pilot framework will be developed in consultation with the Services, EPA, and other ESA experts to identify and incorporate science-based conservation benefits at relevant steps during informal or formal consultation. This approach allows for more expeditious review because conservation benefits can minimize and offset potential, modeled, or uncertain effects that might otherwise require more complicated analysis during consultations. We expect that the overall effects to the species will be neutral, beneficial, or less harmful than if no conservation occurred. Approaches that are consistent with Services' current regulations, proposed regulations, and current practices will be explored.

10 Comments/Corrections

BE Chapter	Chapter 2; Chapter 4 - Appendix 4-2
Section Title:	Endpoints used in Effects Determination
Table:	2-1
Page No.:	2-8
Comment No.:	1
EPA Statement	*NA*

Syngenta Comments:
Table 2-1 in Chapter 2 of the Thiamethoxam BE lists the Japanese quail LD50 value as a thiamethoxam study endpoint. The MRID number listed refers to the mallard acute toxicity study for thiamethoxam. This is an error as the Japanese quail study is a clothianidin study as stated in Chapter 2, section 8.8, of the Thiamethoxam BE. The Toxicity Inputs tab in the Excel file in Appendix 4-2 lists the LD50 and slope value for Japanese quail of 423 mg ai/kg-bw and 4.5, respectively as input values for mortality for Birds and Reptiles/Terrestrial Amphibians however this endpoint was not identified as being determined from a clothianidin study in the spreadsheet as was done for other endpoints determined from clothianidin studies. As indicated previously in this document, Syngenta posits that thiamethoxam endpoints should be used when available and therefore recommends the canary, *Serinus canaria,* LD50 of 431 mg ai/kg-bw with a slope of 5.6 (MRID 49755701) be used as the input value in the MAGtool.

Appendices

Appendix 1.0. Growing Matters – Review of the EPA Draft Neonicotinoid Biological Evaluations

REVIEW OF THE EPA DRAFT NEONICOTINOID BIOLOGICAL EVALUATIONS

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Date: October 25th, 2021

DISCLAIMER

Intrinsik Ltd. and Stone Environmental Inc. developed this report for Valent U.S.A. LLC ("Valent"), solely for the purpose stated in the report.

Intrinsik Ltd. and Stone Environmental Inc. do not accept any responsibility or liability related to the improper use of this report or incorrect data or information provided by others.

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1.0 INTRODUCTION

The Agency released three Draft National Level Listed Species Biological Evaluations (BE) for Clothianidin, Imidacloprid, Thiamethoxam on August 26th, 2021 (EPA, 2021a,b,c) (draft BEs). Registration of pesticides under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) constitutes a Federal action under the Endangered Species Act (ESA). Under Section 7 of the ESA and the implementing regulations, if the Environmental Protection Agency (EPA or "the Agency") determines that its action "may affect" species, it must consult with the Fish and Wildlife Service and/or National Marine Fisheries Service ("the Services") to ensure that a pesticide's registration (the Federal action) is not likely to result in the destruction or adverse modification of designated critical habitat or jeopardize the continued existence of Federally threatened, endangered, and proposed species (hereafter, "listed species"). Although EPA also reviews candidate species in their BEs, they do not have protections under the ESA. EPA evaluates these species only in the context that they may be proposed for listing at a future date.

The purpose of the draft BEs is to assess potential risks that registered uses of these three neonicotinoids may pose to listed species and designated critical habitats in the United States. Thus, registered uses and agreed upon changes to labels from technical registrants and approved product labels for pesticide products containing clothianidin, imidacloprid, and thiamethoxam are evaluated.

The methods employed in the three draft BEs followed the Revised Method for National Level Listed Species Biological Evaluations of Conventional Pesticides (referred to as the "Revised Method"; EPA, 2020a).[1] Comments from registrants were provided on the Revised Methods from a wide variety of sources and submitted to the docket during the public comment period (see Docket EPA-HQ-OPP-2021-0090). Additional comments were provided by CropLife America (CLA, 2020) on the Revised Methods within the context of their application in the carbamate BEs (i.e., carbaryl (EPA, 2020c) and methomyl (EPA, 2020d)).

A significant component of EPA's Biological Evaluations from the carbamates on is the application of the Magnitude of Effect Tool (MAGtool).[2] The MAGtool is intended to assist EPA in efficiently evaluating the risks of potential pesticide use on listed species and designated critical habitats. The tool is intended to estimate the number of individuals of each listed species potentially impacted by a pesticide due to mortality losses or adverse sublethal effects. The tool is also intended to determine if there is the potential for adverse impacts on prey, pollinators, habitat, and/or biological dispersers (PPHD) upon which listed species depend. In their

[1] Available at: https://www.epa.gov/endangered-species/revised-method-national-level-listed-species-biological-evaluations-conventional

[2] https://www.epa.gov/endangered-species/models-and-tools-national-level-listed-species-biological-evaluations-carbaryl#MAGtool

description of the MAGtool, EPA states that within the output generated for each listed species is the potential number of individuals that "could be" impacted under the highly conservative model assumptions, and the results are not a prediction that they "will be" impacted. Thus, in addition to the many flaws described below, the Revised Method and its implementing tools (e.g., MAGtool) do not address, and are not even designed to address, whether a potential for adverse effect to a listed species is reasonably certain to occur as described in the Services recently amended Endangered Species Act regulations (See 50 CFR § 402.02).

As part of the of the review process, Growing Matters, a group comprised of the registrants, BASF, Bayer, Mitsui, Valent, and Syngenta, retained Intrinsik Corp. (Intrinsik) and Stone Environmental Inc. (Stone) to review the draft BEs (EPA, 2021a,b,c). The focus of this review is to prepare comments that are common to all three neonicotinoids BEs with respect to:

1. The Revised Method (Section 2)
2. Use Data Layers (UDL) (Section 3)
3. Magnitude of Effect Tool (MAGtool) (Section 4)
4. Plant Assessment Tool (PAT) (Section 5)
5. Additional comments that apply to the three neonicotinoids (Section 6).

The comments do not address chemical specific issues although examples from each of the three neonicotinoid BEs are used to provide examples. The draft BEs and associated MAGtool files were all downloaded on August 27th, 2021, from the EPA draft BE and MAGtool websites.[3,4]

2.0 APPLICATION OF THE REVISED METHOD

Many concerns have been previously documented and submitted to the appropriate dockets, with respect to the application of the Revised Method to the pesticides previously evaluated (e.g., CLA, 2021a,b; Teed et al. 2021a; Teed et al. 2021b). For example, issues with compounding conservatism, inadequate weight-of-evidence approach, utility of the confidence evaluation, lack of higher tier studies and full consideration of other appropriate lines of evidence. These comments remain valid for the neonicotinoid draft BEs.

These draft BEs assign effects determinations (NE, MA, NLAA, or LAA)[5] for 1821 listed species, and 791 designated critical habitats. For clothianidin under Step 1, EPA made NE

[3] Models and Tools for National Level Listed Species Biological Evaluations of Neonicotinoid Insecticides | US EPA

[4] Draft National Level Listed Species Biological Evaluation for Clothianidin | US EPA

[5] NE = No effect. MA = May affect. NLAA = Not likely to adversely affect. LAA = Likely to adversely affect.

determinations for 259 species and 131 critical habitats primarily due to a lack of direct (Step 1b) and indirect effects (Step 1c). Similarly, for thiamethoxam and imidacloprid, most of the NE determinations were due to a lack of direct (Step 1b) or indirect effects (Step 1c). EPA made MA determinations for ≥1562 species and ≥660 critical habitats for the compounds thus triggering formal or informal consultations with the Services. Of the MA determinations based on listed species range, 68.6 to 86.3% were identified as LAA due to indirect effects (PPHD).

Table 2-1. Summary of effect determinations for the three neonicotinoids

	No Effect	May Affect	Direct	Indirect/PPHD
			LAA[1]	LAA[1]
Clothianidin				
Listed Species	259	1,562	168 (13.7%)	1,057 (86.3%)
Critical Habitat	131	660		
Imidacloprid				
Listed Species	209	1,612	505 (23.0%)	1,107 (77.0%)
Critical Habitat	78	713		
Thiamethoxam				
Listed Species	221	1,600	392 (13.5%)[1]	1,208 (86.5%)[1]
Critical Habitat	89	702		

[1] – Percentages based on number of MA/LAA results only and does not include the NLAA results

From the perspective of the use data layers (UDL) associated with the effect determinations of MA/LAA, the Top 5 were open space developed, developed, poultry litter, other crops, and vegetables and ground fruit (see Chapter 4 of the draft BEs; EPA 2021a,b,c).

In the following sections, we generally describe how EPA arrived at the results in the draft BE from a policy and procedures perspective and provide comments on key aspects of the BE approach starting with the Revised Method (EPA, 2020a).

2.1 Application of the Revised Method to the Neonicotinoids

EPA released their Revised Method for National Level Listed Species Biological Evaluations of Conventional Pesticides ("Revised Method") in March 2020 (EPA, 2020a). Figure 2-1 and Figure 2-2 illustrate generally how the Revised Method moves through Steps 1 and 2 to assign effect determinations to each listed species and critical habitat evaluated. In Step 1, the Agency focusses on whether there is the potential for overlap of a species range or critical habitat with the action area (i.e., where the pesticide could potentially be used plus consideration of the potential for movement away from the use site). Step 1 also considered whether there may be potential for direct (Step 1b) or indirect (prey, pollination, habitat and/or dispersal) (Step 1c) adverse effects. All analyses in Step 1 are meant to be extremely conservative and thus loses its effectiveness in predicting where potential effects may reasonably be expected to occur. No conclusions can be drawn from Step 1 that would suggest a listed species or critical habitat may *actually* be experiencing adverse effects due to the potential for exposure to a pesticide.

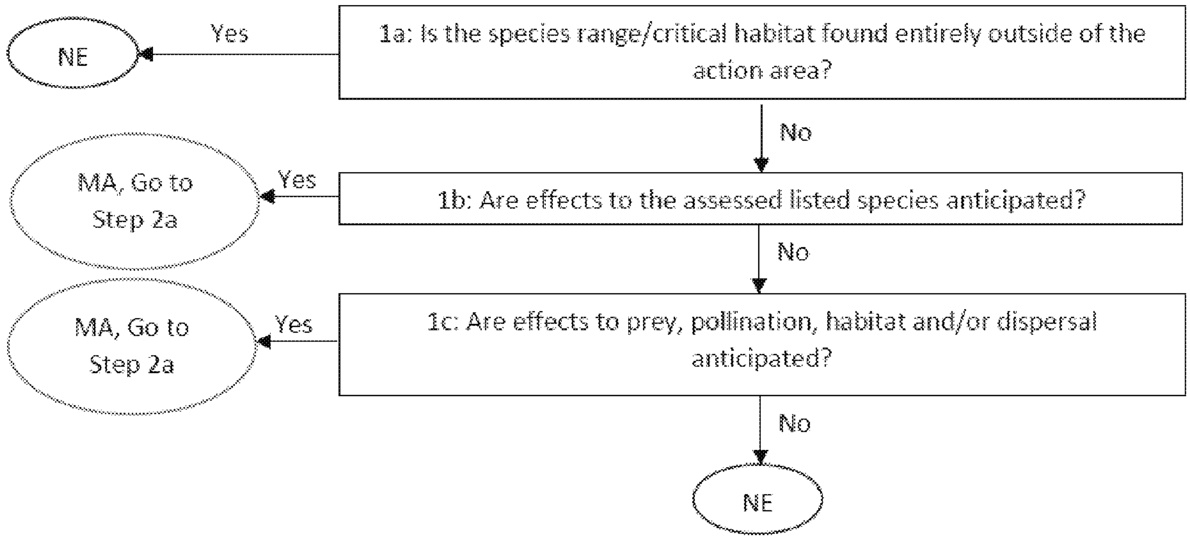


Figure 2-1. Step 1 of the Revised Guidance for Making No Effect (NE) and May Affect (MA) Determinations (From EPA, 2020a)

Figure 2 illustrates the Step 2 process from Step 2a to Step 2i. In Steps 2a to 2e the Agency applies both qualitative and quantitative, generic filters to remove listed species and critical habitats from the BE. For example, whether or not a species is unlikely to be exposed (Step 2a); considered extinct (Step 2b); there is a clear indication the species range spatial data and/or use data are unreliable (Step 2c); EPA does not have an appropriate method to estimate exposure for some species and the methods that are applied are considered unreliable (Step 2d); and there is such a small area overlapping (action area with species range) that it is within the bounds of the spatial error anticipated given the spatial data resolution (Step 2e). All of these bring limited and simplistic (e.g., extinction/extirpation) species-specific information into the BE, and to be efficient, all these sub-steps (2a-e) realistically should be addressed in the BE problem formulation, thereby simplifying Step 2.

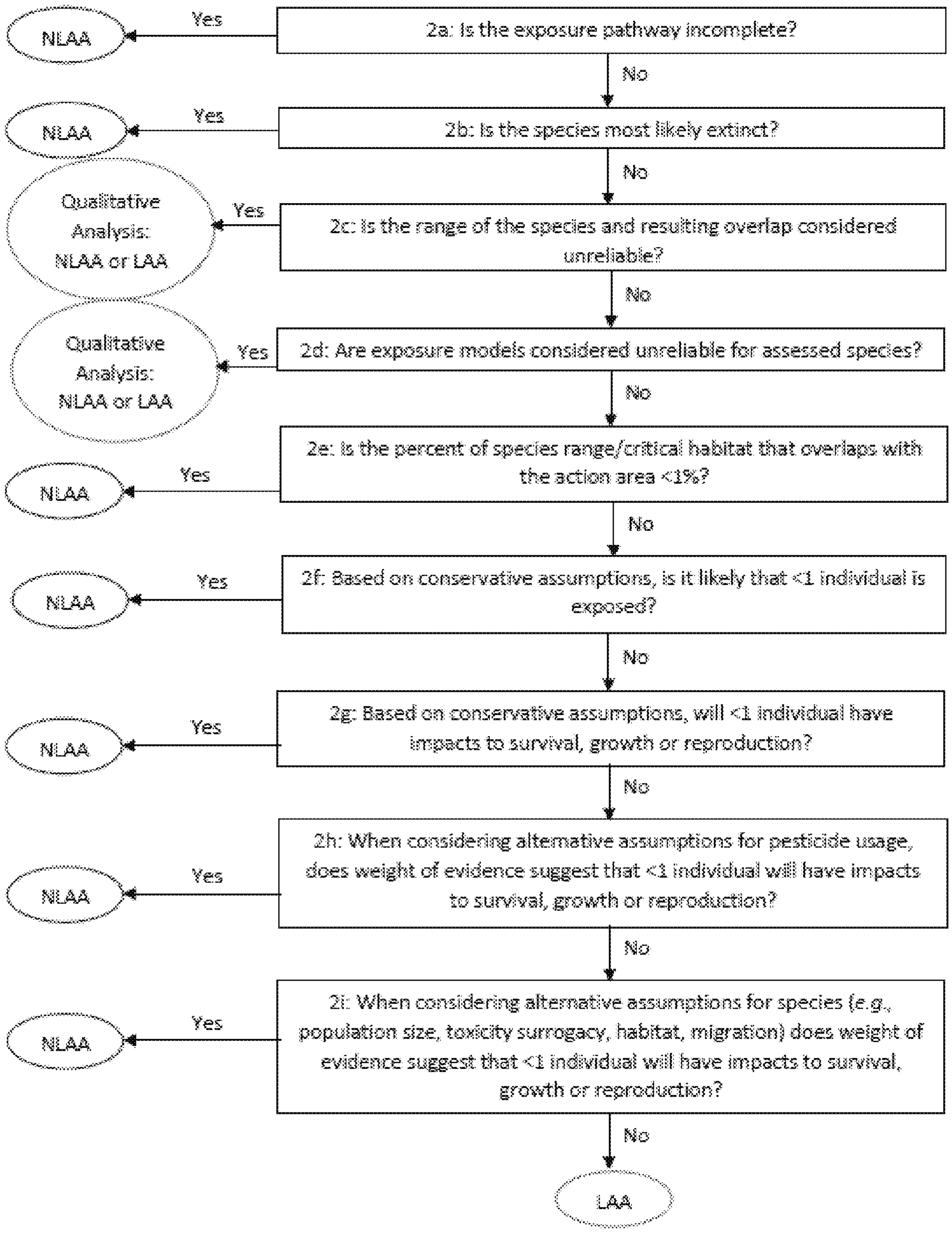


Figure 2-2. Step 2 of the Revised Guidance for Making Likely to Adversely Affect (LAA) and Not Likely to Adversely Affect (NLAA) Determinations

From Step 2f to 2i, the MAGtool plays a significant role in 'consistently' applying the Revised Method. In each of the remaining sub-steps, EPA points out that conservative assumptions are used to assign an effect determination (Figure 2-2). In fact, these conservative assumptions are heavily compounded (see Section 2.2) and the way the tools are designed, there is limited ability to apply refinement using species-specific information. Thus, once a listed species or critical habitat enters Step 2f, the Revised Method is inherently designed to all but ensure a LAA effect determination. Adjustments based on some additional species-specific information (e.g., spray drift risk mitigated by the species habitat such as old growth forest) applied in a qualitative way can result in few adjustments from LAA to NLAA (see all the draft BEs, Attachment 4-1, page 8). Table 2-2 summarizes the listed species/critical habitats assigned a specific effect determination as they move through the Revised Method for clothianidin, as an example.

Table 2-2. Summary of Species Effect Determinations by Step (and Part) in the Process (from EPA, 2021a)(Clothianidin example)

	Step 1A	Step 1B/C	Step 2A	Step 2B	Step 2C		Step 2D		Step 2E	Step 2F	Step 2G/H/I	
	Outside of the action area	No toxicity effects	Incomplete exposure pathway	Extinct	Unreliable overlap based on range		Exposure models unreliable		<1% overlap	<1 exposed and pop. >100	Weight of evidence	
	NE	NE	NLAA	NLAA	NLAA	LAA	NLAA	LAA	NLAA	NLAA	NLAA	LAA
Species	43	216	52	17	10	7	56	1	29	28	145	1217
Critical Habitat	60	71	18	2	0	4	15	1	59	35	85	441

CropLife America commented on the application of the Revised Method to the Draft Biological Evaluation for Carbaryl and Methomyl (CLA, 2020) and noted that "the draft carbamate BEs show some incremental improvements to the BE development process. But improvements are uneven and the Revised Method's practical application in the draft carbamate BEs demonstrates that the Agency has not yet reached a workable, legally defensible, or sustainable approach to listed species risk assessments." The Agency's response to that comment (EPA, 2021d) was "*EPA is using an iterative process for developing methods and conducting national-level BEs. The methods used to develop BEs will continue to evolve as EPA gains experience and as scientific methods and data improve. EPA will continue to evaluate approaches for improving the efficiency of developing national-level BEs. EPA's application of the Revised Method, which was developed through a transparent process (including working with the Services), is scientifically based and robust, and legally defensible.*"

The Agency's response on this issue remains at odds with stakeholders view of the application of the Revised Method to more recent draft BEs (e.g., herbicides) (see CLA, 2021c; Teed et al. 2021a,b; Syngenta, 2021). Although it is recognized that both timelines and resources remain a challenge for all parties, the Revised Method does not lead to a BE development process that is transparent (see Section 6.1), sustainable given the number of annual federal actions (see FIFRA registration review schedules[6] for annual federal actions reviewable under the ESA), has many unanswered questions on its scientific robustness, and in our opinion, remain outside of the Services' new Endangered Species Act (ESA) regulations (Consultation Procedures, 2019).

[6] Registration Review Schedules | US EPA

2.2 Compounding Conservatism

Conservative assumptions can be useful to quickly eliminate routes of exposure and listed species and/or critical habitat that are tolerant of both direct and indirect adverse effects from further assessment effort. This type of highly conservative analysis is the standard practice in all EPA risk assessment framework guidance that has been in use for decades (e.g., EPA, 1992; EPA, 1998; EPA, 2004) and recommended in the NRC Panel report (NRC, 2013). However, in all cases, the guidance compels the risk assessor to move forward with refined analyses to characterize risk. In fact, because a typical Tier 1/Step 1 or screening-level risk assessment is intended to be so highly conservative, all that can be said regarding its outcome is that the possibility of risk, for those species that screen through, cannot be excluded out of hand. This is consistent with EPA's statement in the draft neonicotinoid BEs that:

"Given the conservative nature of the Step 1 and Step 2 analysis, EPA is confident that when a NE or NLAA determination is made, there will be no effects to an individual of the assessed species or an individual of a species is not likely to be adversely affected." (draft BEs Chapter 4)

Assigning a May Affect determination in Step 1 therefore <u>cannot</u> meet the ESA regulations standard of 'reasonably certain to occur' as described in the Services' new Endangered Species Act (ESA) regulation (Sec 50 CFR § 402.02) (Interagency Cooperation-Endangered Species Act of 1973, as Amended, 2019). Despite this, the Agency uses Step 1 to evaluate whether the effect determination should be 'No Effect' or 'May Affect', thereby triggering unnecessary consultations with the Services under ESA Section 7. This occurs even though extremely limited species-specific data are considered (e.g., listed species and critical habitat spatial data; generalized dietary/habitat information) and the action areas that are extremely exaggerated. A reasonable interpretation of the application of 'best available data' as dictated by the ESA when characterizing risk to listed species is also not met in Step 1 and 2 and yet the consequences are significant in terms of time and resources, due to the requirement for EPA to consult with the Services when a May Affect determination is made. Refinement is clearly a missing component of the draft neonicotinoid BEs despite the description of how the BE is refined in Step 2. This is alluded to by EPA on Page 6 of the Executive Summaries (EPA, 2021a,b,c) where EPA states:

"*Additionally, EPA makes an LAA determination when there is the potential for a single individual of a species to be affected by the labeled use of a pesticide, which is a conservative threshold. This often results in a high number of LAA determinations. An LAA determination in the draft BE should not be interpreted to mean that EPA has determined that the registered use of clothianidin is putting a listed species in jeopardy. The National Marine Fisheries Service and the Fish and Wildlife Service make those determinations.*"

This text is a welcome addition to the draft BE language and elevated previous statements made by EPA such where EPA states in Chapter 4:

"It is important to note that the output generated is the potential number of individuals that could be impacted (based on the assumptions in the simulation), not a prediction that they will be impacted. Throughout this analysis, the BE maintains conservative assumptions and may overstate the number of species exposed to and impacted by a pesticide."

These statements also serve to highlight the fact that the Revised Method is not designed to effectively identify listed species or critical habitat that may be 'reasonably certain' to be at risk from the federal action as per the Consultation Procedures (2019). ESA Consultation Procedures (2019) Section 402.17 (50 CFR Part 402) clarifies that for a consequence or an activity to be considered reasonably certain to occur, the determination must be based on clear and substantial information. This means there must be a firm basis to support the conclusion that the consequence of the action is reasonably certain to occur. It does not mean that the consequence of the action is guaranteed to occur, but it must have a degree of certitude. This has not been achieved using the tools applied in the draft neonicotinoid BEs.

In the absence of data (e.g., toxicity tests for listed species) or in the presence of naturally variable data such as weather, risk assessments must be performed using reasonable and conservative assumptions that account for uncertainty. Having compounded conservative assumptions throughout the draft BE, to give the 'benefit of doubt' to the listed species, leads to completely unrealistic exposure estimates that are not reasonably certain to occur. Combining unrealistic exposure estimates with protection goals that are an extremely 'low bar' (e.g., one individual out of an estimated species population) and there is little chance any listed species would ever receive anything but a MA/LAA effect determination rendering the application of refined considerations in Step 2 essentially moot.

Identifying the uncertainties that lead to conservative assumptions and communicating the impact of that uncertainty is critically important. The Agency did endeavor to identify sources of uncertainty in the draft BE but provided a very incomplete picture of their impact. For example, in Chapter 4 of all the draft neonicotinoid BEs (Page 4-13), EPA states:

"Threshold for assessing impacts on prey, pollination, habitat, dispersal (PPHD) of a species. There are uncertainties associated with the magnitude of impact to a particular species' prey base or habitat for a given pesticide that could result in a discernible effect to that listed species."

What EPA does not explain, is how this source of uncertainty affected the risk characterization and effect determination calls. Conservative effects endpoints are selected to represent the sensitivity of PPHD species (see Refined Method (EPA, 2020a) - Table 3). However, the PPHD analysis does not include consideration of diet variability, diet specificity, species mobility, variability in pesticide tolerance of PPHD communities, nor factors such as community recovery. Therefore, the PPHD analyses can have a significant impact on the effect determinations and bias the analyses towards LAA findings which is the case with the draft neonicotinoids BEs (see Table 2-1).

The assumptions surrounding the poultry litter use pattern is another example of this. EPA identified all uses where poultry litter may be used as an input in counties where poultry operations occur. The Agency then assumed that poultry litter would be used as an amendment throughout these entire counties and noted that this assumption could potentially overestimate the overlap of the poultry litter use pattern with listed species ranges and critical habitats. In fact, this assumption does significantly overestimate the overlap as documented further in the comments below (see Section 3.2) and is a key assumption leading to a MA/LAA determination for many of the listed species evaluated.

3.0 ANALYSIS OF USAGE DATA APPROACH AND PERCENT CROP TREATED

3.1 Overview

Neonicotinoid usage data incorporated into the draft BEs are summarized in the Summary Use and Usage Matrix (SUUM) documents, Appendix 1-4 of each BE (EPA, 2021a; EPA, 2021b; EPA, 2021c). This appendix documents agricultural and non-agricultural neonicotinoid uses at the state and national scales. The primary data sources for agricultural uses were Kynetec USA (Kynetec, 2021), US Department of Agriculture National Agricultural Statistics Service (NASS) (USDA, 2021), and the California Department of Pesticide Regulation (CDPR) Pesticide Use Reporting (PUR) database (CDPR, 2021). For non-agricultural uses, the primary data source was proprietary survey data compiled by Kline and Company (Kline, 2014; Kline, 2016; Kline and Company, 2017a; Kline and Company 2017b).

The usage data are reported by use site. For example, agricultural usage is reported independently by crop group (e.g., Tuberous and Corm Vegetables) and by individual crops (e.g., potato), while non-agricultural usage data are reported independently by use site (e.g., trees, food processing plants, and consumer market indoor/outdoor). The most important data reported for the agricultural use sites is the Percent Crop Treated (PCT), provided in Table 2 of Appendix 1-4 (EPA, 2021a; EPA 2021b; EPA, 2021c). A minimum, average, and maximum PCT are reported at the use site/state level and are based on evaluation of the most recent five years of available usage and crop production data. These PCT values are then used to adjust the overlap area of the Use Data Layers (UDLs) with the range and critical habitat area for each species, as described in Appendix 1-7, Section 2.1 (EPA, 2021a; EPA, 2021b, EPA 2021c). A PCT value for a given crop and year is calculated as the acres treated divided by the crop acreage grown in the same year. The acres treated by crop are reported in source datasets (i.e., AgroTrak for agricultural uses). It is critical to understand that this approach to PCT calculations does not consider multiple applications on the same land or actual application rates. As noted in Section 2.1 of Appendix 1-7 of the draft BEs, this represents a conservative assumption, as the same land may be treated multiple times in a year, thus inflating the acres treated and PCT. The absence of an application rate in the consideration of a PCT estimation implicitly assumes that the acres treated are in alignment with the application rate and number of applications assumed in any exposure magnitude calculations. The exposure scenarios simulated in the draft BEs assume maximum label rates (maximum single and maximum cumulative annual rates), which are always higher than the rates implicit in the PCTs reported in SUUMs.

The individual crop PCT values are then aggregated for each state and UDL for each year of usage data. For UDLs that contain multiple crops, (such as "Vegetables and Ground Fruit"), the aggregated PCT represents the total acres treated for all crops in the UDL divided by the total acres grown for all crops in the UDL. The PCT for a UDL multiplied by the associated acres grown within a state for the crops in the UDL determines the acres treated for each UDL. The total acres treated in a state are then determined by summing the acres treated across all UDLs, both agricultural and non-agricultural.

The primary purpose of the PCT results in the neonicotinoid draft BEs was to adjust the overlay analysis between neonicotinoid use sites and species ranges or critical habitat to account for the fact that not all potential use sites represented in UDLs are treated in a given year. The detailed discussion of the overlap likelihood analysis in the neonicotinoid BEs Appendix 1-7 (EPA, 2021a; EPA, 2021b; EPA 2021c), as well as sections of the Revised Methodology for BEs (EPA, 2020a), describe potentially 37 different overlap analyses to be conducted. In addition to the worst-case overlap scenario that does not consider usage data, there are 36 alternative scenarios constructed from nine different PCT/usage distribution assumptions, and four alternative overlay methodologies. The nine PCT/usage distribution scenarios included: 1) max/upper, 2) max/uniform, 3) max/lower, 4) average/upper, 5) average/uniform, 6) average/lower, 7) min/upper, 8) min/uniform, and 9) min/lower. In these scenarios, max, average, and lower refer to the state and UDL-level PCT calculated, while upper, uniform, and lower refer to how the treated acres in each UDL are apportioned within or outside of a species range/critical habitat (upper = within range, lower = outside range, and uniform indicates equally distributed within and outside range). The five overlap scenarios include: 1) Unadjusted (no PCT), 2) PCT Overlap, 3) PCT and Redundancy, 4) PCT, Redundancy, Off-site, and 5) PCT, Redundancy, Off-site, Habitat. Here, PCT indicates that one of the PCT scenarios was considered, "Redundancy" indicates that overlapping of individual UDLs was corrected for, "Off-site" indicates that a species was assumed to not occur directly on a use site, and "Habitat" indicates that a species range was refined with land cover/vegetation data based on the species life history.

The MAGtool then uses PCTs derived from the methods described above to project the number of individuals in the population that are exposed to use of the pesticide for each UDL. Species with higher populations result in higher numbers of individuals exposed for a given PCT and resulting percent overlap. As such the spatial extent of UDLs and the PCTs associated with those UDLs have significant influence over the outcomes of MAGtool analyses.

3.2 Critique of Methodology and Recommendations

The PCT calculations in the neonicotinoid BEs were a critical component to Step 2 of the effects determinations. The methods by which PCTs were calculated, including the maximum and average PCT values used in the BEs, have a significant impact on the overlap percentages calculated and used in making both a NLAA/LAA decision and in categorizing the confidence in the weight of evidence analysis. A critique of the analysis methods and their potential impacts on the outcome of the assessment for each species are listed below, with distinctions for those that apply to agricultural uses, non-agricultural, and both types of uses identified.

1. ***Agricultural PCTs: The Acreage Used in Calculating Treated Acres Does Not Account for Acres Treated More Than Once in a Season, Leading to Overly Conservative PCT Estimates:*** Section 2.1 of Appendix 1-7 of the neonicotinoid BEs (EPA, 2021a; EPA, 2021b; EPA, 2021c), in describing the approach for calculating PCT for agricultural uses, states, "One conservative assumption of this approach is that it does not account for multiple applications to the same fields. Usage data represents the potential acres where at least one Neonicotinoid application occurred. The data does not identify sites where multiple applications occur within the same year. The approach used here assumes that all treated acres are independent." In addition, in Table 1 of Appendix 4-1 (EPA, 2021a; EPA, 2021b; EPA, 2021c), footnote *b* states that, "Total Acres Treated accounts for multiple applications to a single area. This may overestimate the number of acres treated as some acres are treated more than once." While it is unknown the full extent to which multiple neonicotinoid applications on the same acreage impacted an overestimation of PCT, this factor could have been estimated and accounted for in the WoE analyses to produce an alternative PCT more representative of the extent of actual usage.

   Recommendation: A methodology for deriving PCT values needs to be established which accounts for multiple applications on the same land or field. The methodology also must be consistent with annual application rates assumed in the exposure modeling, as the MAGtool analysis considers both exposure likelihood and exposure magnitude concurrently. For some UDLs, information from AgroTrak or California PUR could be used to assess actual annual application rates and account for multiple applications to refine PCTs and address this conservatism that resulted in overestimated PCT values for agricultural UDLs.

2. ***Agricultural PCTs: The Methodology Used in Calculating a PCT Is Inconsistent with the Exposure Modeling Which Assumes Applications to Use Sites at Maximum Annual***

Label Rates: The exposure modeling in Step 1 and Step 2 assumes maximum single and maximum annual application rates. The methodology used to calculate PCT in the neonicotinoid BEs did not consider application rates assumed in the exposure modeling, leading to an inconsistency between the PCT (used to determine likelihood of overlap) and magnitude of exposure, both of which are considered together in the WoE analysis Steps 2g/h/i. The appropriate approach for calculating PCT, which also addresses not accounting for multiple applications to the same acreage, is to calculate the acres treated as the total pounds applied divided by the annual application rate. The PCT is then calculated as the acres treated divided by the acres grown for a given year.

As a comparison to the PCTs from the neonicotinoid BEs, this more appropriate PCT calculation approach was applied using state level neonicotinoid usage and crop acreage data taken directly from Appendix 1-4 of the three BEs (EPA, 2021a; EPA, 2021b; EPA, 2021c). In Table 2 of Appendix 1-4, average crop acres grown and average annual usage data (pounds per year) are provided for multiple state and crop combinations. A subset of this data, taken from all three BEs, is provided in Table 3-1 below. Additional information provided in the table includes average PCT for the state/crop combination (also from Appendix 1-4), and the modeled annual application rate extracted from Appendix 1-3. The "Avg. Acres Treated, Modeled Rate" is calculated as the average annual pounds applied by the modeled application rate, with the "PCT, Modeled Rate" equal to the treated acres divided by the total crop acres. The "BE PCT Overestimation Factor" is then the ratio of the PCT based on the modeled application rates to the average PCT from the BE. These examples show that PCTs drawn from Appendix 1-4 in the BEs overestimate PCT consistent with the exposure modeling by factors between 2.4 and 10.0 for clothianidin, factors of between 3.43 and 7.50 for imidacloprid, and factors of between 2.45 and 4.88 for thiamethoxam. These overestimates of PCT can lead to substantial over-representation of usage. For example, the PCT overestimate for thiamethoxam on soybeans results in an average 38,750 extra pounds applied annually.

This example evaluation highlights the over-estimation of the PCT values used in the BE relative to the application rates assumed in the exposure modeling for each of the three neonicotinoid BEs. The PCT assumed is analogous to the probability of exposure, therefore in our agricultural use examples here, the likelihood of exposure is often more than three times higher than it should be based on the application rates assumed in the exposure modeling. In Step 2g, 2h, and 2i, both the likelihood of exposure AND the magnitude of exposure are considered concurrently. The inconsistency in the determination of PCT (dictating likelihood of exposure) and the exposure magnitude (directly a function of application rate assumptions) makes the WoE analysis conducted in these steps of the effect determinations unrepresentative of the actual potential impacts on individuals of a given species population, as the impacts would be much lower.

Recommendation: A methodology for calculation of PCT must be derived that ensures consistency with annual application rates assumed in the exposure modeling. As noted in the previous comment, the MAGtool analysis considers both exposure likelihood and exposure magnitude concurrently, thus consistency in the base assumptions must be maintained. The suggested approach is to evaluate PCT on an annual basis, determining the treatable acres from a single year of a UDL and the associated usage data reported from that same year. The treated acres for a state and UDL are then calculated as the total annual usage divided by the annual application rate. When the application rate used in the exposure modeling is the maximum annual, then this is the rate that should be used in calculating the treated acres for the given year. The PCT is then simply calculated as the treated acres divided by the treatable acres (derived from a single UDL year). Multiple years of UDLs considered independently results in multiple PCTs and treated areas by state and UDL which can be considered when calculating maximum and average usage scenarios. More information on the approach is provided in Winchell et al. (2020).

Table 3-1. Comparisons of PCTs from the Biological Evaluation (BE) with PCTs from Max Annual Rate Assumption									
Active	***Crop***	***State***	***Modeled Rate (lb/ac-yr)[1]***	***Avg. Crop Acres[2]***	***Avg. Pounds Applied[2]***	***Avg. Acres Treated, Modeled Rate***	***PCT, Modeled Rate (%)***	***PCT, BE Avg.[2] (%)***	***BE PCT Overestimation Factor***
Clothianidin	Almonds	CA	0.4	1,000,000	1,000	2,500	0.3	2.5	10.00
Clothianidin	Grapes	CA	0.2	900,000	5,000	25,000	2.8	12.5	4.50
Clothianidin	Tomatoes	CA	0.2	300,000	900	4,500	1.5	5.0	3.33
Clothianidin	Apples	MI	0.2	40,000	1,000	5,000	12.5	30.0	2.40
Imidacloprid	Potato	WA	0.52	200,000	7,000	13,462	6.7	35.0	5.20
Imidacloprid	Lettuce	CA	0.49	200,000	20,000	40,816	20.4	70.0	3.43
Imidacloprid	Soybeans	IL	0.134	10,300,000	10,000	74,627	0.7	5.0	6.90
Imidacloprid	Apple	NY	0.49	50,000	500	1,020	2.0	15.0	7.35
Imidacloprid	Cotton	MS	0.5	500,000	10,000	20,000	4.0	30.0	7.50
Imidacloprid	Tobacco	NC	0.49	200,000	5,000	10,204	5.1	20.0	3.92
Thiamethoxam	Lettuce	AZ	0.175	70,000	500	2,857	4.1	10.0	2.45
Thiamethoxam	Soybeans	MN	0.125	7,800,000	10,000	80,000	1.0	5.0	4.88
Thiamethoxam	Apples	NY	0.258	50,000	2,000	7,752	15.5	65.0	4.19
Thiamethoxam	Cotton	SC	0.125	200,000	600	4,800	2.4	10.0	4.17

1) Modeled application rate taken from BE Appendix 1-3, aquatic exposure modeling scenarios

2) Average crop acres, pounds applied, and BE PCT from BE Appendix 1-4, summary use and usage matrix

3. ***Agricultural PCTs: A UDL Minimum PCT of 2.5% Results in Excessive Overestimation of Usage for Some Crops and States:*** In situations where no usage was reported, or where PCTs in the SUUMs (Appendix 1-4, Table 2) were reported as "< 1%" or "< 2.5%", then the PCT was assumed to be 2.5% for that crop and state. This ultimately rolled up to the state-level PCTs for the associated UDL being set to 2.5% in the MAGtool inputs. Setting PCTs to be a minimum of 2.5% results in excessive overestimation of usage for some crops, particularly large acreage crops. An example for soybeans, pulled from all three neonicotinoids, is provided in Table 3-2 below. The states listed in the table all had soybean PCTs reported as < 1%, < 2.5%, or no usage reported ("NR"). In all these cases, PCT was set to the 2.5% minimum. We assumed that the "actual estimate" PCT would be 0% for cases of no usage reported, 0.5% for cases of < 1%, and 1.75% for cases of < 2.5% (most of the examples provided were targeted to be the <1% cases). The usage overestimate for each is then calculated by taking the difference between the MAGtool PCT and the "actual estimate" PCT and multiplying that difference by the application rate and the crop acres. For the states with high acreage of soybeans (over 1 million acres) and reported PCT of <1%, the usage overestimation ranged between 13,500 and 30,938 pounds applied annually. In the case of clothianidin, the usage overestimation represented by just the three examples shown accounts for more than the average total agricultural annual usage of 50,000 pounds reported in Chapter 1, Section 4.2 (EPA, 2021a). For imidacloprid and thiamethoxan, the usage overestimation from these three soybean state examples represents a substantial portion of the total reported agricultural usage.

Table 3-2. Impacts a 2.5% Minimum PCT on Estimated Soybean Annual Usage

Active	*State*	*Modeled Application Rate (lb/ac-yr)*[1]	*Avg. Crop Acres*[2]	*PCT, SUUM Avg.*[2] *(%)*	*PCT, Actual Estimate (%)*	*PCT, MAGtool (%)*	*Usage Overestimate (lbs)*
Clothianidin	AL	0.2	500,000	< 1%	0.50	2.5	2,000
Clothianidin	AR	0.2	3,400,000	< 2.5%	1.75	2.5	5,100
Clothianidin	IL	0.2	10,300,000	NR	0.00	2.5	51,500
Imidacloprid	IN	0.134	5,800,000	< 1	0.50	2.5	15,544
Imidacloprid	ND	0.134	6,300,000	< 1	0.50	2.5	16,884
Imidacloprid	SD	0.134	5,200,000	< 1	0.50	2.5	13,936
Thiamethoxam	IA	0.125	9,900,000	< 1	0.00	2.5	30,938
Thiamethoxam	IN	0.125	5,800,000	< 1	0.00	2.5	18,125
Thiamethoxam	NE	0.125	5,400,000	< 1	0.50	2.5	13,500

1.) Modeled application rate taken from BE Appendix 1-3, aquatic exposure modeling scenarios

2) Average crop acres, pounds applied, and "PCT, SUUM" from BE Appendix 1-4

Recommendation: The assumption of a minimum PCT of 2.5% is too high, as it results in unrealistic usage estimates that are not supported by best available datasets. A substantially lower minimum would be more appropriate in cases where the available PCT indicates < 1% or no usage, especially in the case of larger acreage crops where seemingly small PCT values can led to substantial amounts of the chemical entering the environment.

4. ***Agricultural PCTs: The Methodology for Applying Surrogate Usage Data to Agricultural UDLs is Overly Conservative and Leads to Unrealistic Usage Assumptions:*** There are cases where usage data has not been surveyed for a given crop and state combination. An approach for applying surrogate usage data from other crops within the same UDL, or the same crop in other states, is described in Section 3 of Appendix 1-7. The flow chart in Section 3 describes the following hierarchy of usage surrogates when specific state and crop level survey data is unavailable:

    - If a PCT is available for a use within the same UDL and state, use the highest PCT of all uses within the UDL and state. If not;
    - If the use is surveyed in other states, use the highest PCT for that crop/use from any other state. If not;
    - Use the highest PCT of any crop in any state.

    For UDLs with many minor crops that are typically not surveyed, such as the Vegetables and Ground Fruit or Other Orchards UDLs, this can often lead to high PCTs assumed for many crops within the UDL, leading to an overly-conservative aggregated PCT for the UDL.

    It is difficult to trace how PCTs were ultimately determined for the UDLs with many crops (i.e., Vegetables and Ground Fruit, Other Orchards, Other Crops. Other Row Crops), and we were unable to locate any documentation or files of the PCTs assumed for individual crops after applying the surrogacy rules just described. However, the results of the surrogacy rules are apparent in the resulting UDL-level PCTs, which are available in the MAGtool input spreadsheets titled, "GIS Input file_Range_Clothianadin.xlsx" (EPA, 2021a), "GIS Input file_Range_Imidacloprid.xlsx" (EPA, 2021b), and "GIS Input file_Range_Thiamethoxam.xlsx" (EPA, 2021c), worksheets "State PCT_max" and "State PCT_avg".

    The "Other Orchards" UDL contains the following orchard crops, essentially all orchard crops other than citrus: Cherries, Peaches, Apples, Other Tree Crops, Pecans, Almonds, Walnuts, Pears, Pistachios, Prunes, Olives, Pomegranates, Nectarines, Plums, and Apricots. The "Other Crops" UDL includes: Other Crops, Clover/Wildflowers, Sod/Grass Seed, Fallow/Idle Cropland, and Aquaculture. In reviewing the SUUM (Appendix 1-4), it is apparent that PCT estimates are often unavailable in some states for the crops within these UDLs, thus the surrogacy rules would have been applied in determining the aggregated UDL PCTs. The "Other Orchards" max PCTs for imidacloprid and thiamethoxam and the "Other Crops" PCTs for clothianidin are shown in Figure 3-1 below. Across the 48 states and three neonicotinoids represented in the figure, only 1 state has a PCT below 50%. For clothianidin "Other Crops", the PCT is less than 90% for only two states. For Imidacloprid and thiamethoxam "Other Orchards", the UDL PCTs are higher than 90% for 75% of the states and 79% of the sates respectively. Based on reviewing the available usage data for these UDLs in the SUUMs (Appendix 1-4), it is clear that the very high PCTs for these UDLs are unsupported by any data, as the PCTs reported in the survey data are overwhelmingly much lower than shown here.

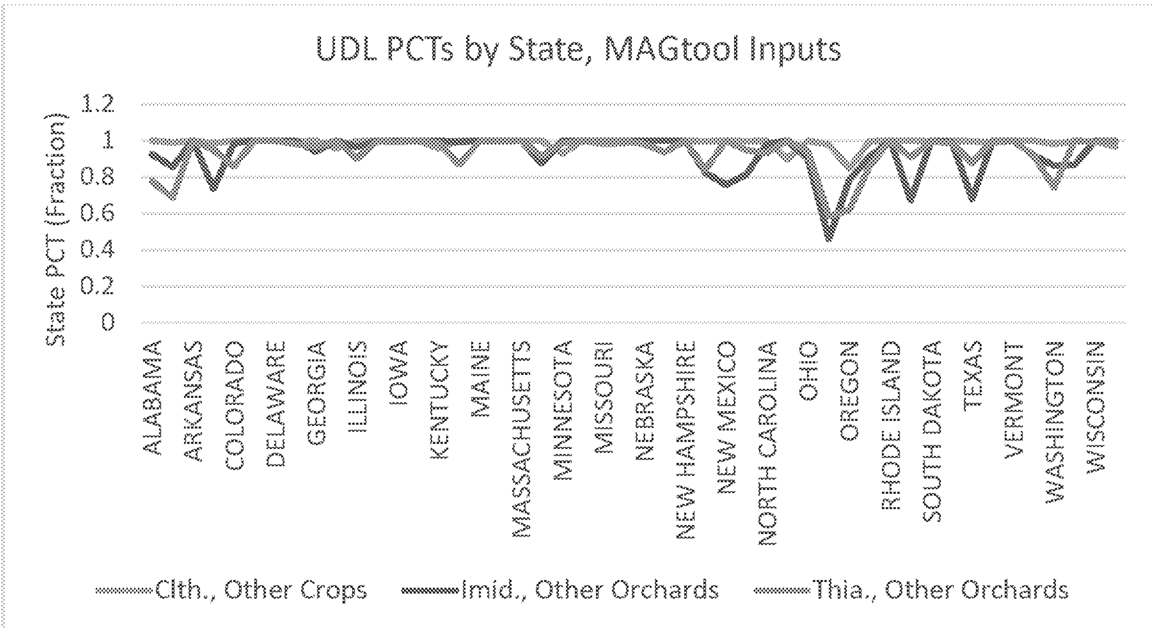


Figure 3-1. MAGtool UDL Max PCTs by State Inputs

Recommendation: The approach for assigning surrogate PCTs to individual crops within a multi-crop UDL needs to be more transparent by producing tables showing the crop-specific PCTs assumed for all crops within a UDL and how the final UDL PCT was derived. In addition, it appears the methodology has produced some unrealistic results, thus should be revised in order to assure that values derived for input to the MAGtool are congruent with best available usage survey datasets and common sense.

5. ***Non-Ag PCTs: The Spatial Extent of the Non-Ag UDLs and Accompanying Assumptions of 100% PCT Lead to Extraordinarily Unrealistic Usage Assumptions and Invalidating the Results of BE:*** Six non-agricultural UDLs were evaluated in the neonicotinoid BE. These included Christmas Trees, Developed, Open Developed, Field Nurseries, Manager Forest, and Poultry Litter. The development of the UDLs associated with these uses is described in Section 4.2 in Appendix 1-6 (EPA, 2021b). The spatial footprints of these UDLs are enormous, with the Developed, Open Space Developed, Managed Forest, and Poultry Litter covering the largest areas. Furthermore, the SUUM (Appendix 1-4) was unable to quantify the amount of neonicotinoid usage for the use sites associated with these UDLs, leading to assumptions of 100% PCT for all of these UDLs (see Appendix 1-7), with the exception of Poultry Litter for thiamethoxam. An analysis was conducted to quantify the amount of usage that these UDLs represents, based on the PCTs assumed in the BEs, in comparison to known information about neonicotinoid usage.

   The spatial footprints for these UDLs were reproduced using the same data sources and processes described in the BE (see Appendix 1-6). From these spatial footprints, the total acreage within the CONUS was calculated, and based on the annual application rate assumed in the exposure modeling scenarios associated with each UDL, the total annual usage within the CONUS was calculated. A short summary of the process for obtaining the CONUS-wide acreages for each UDL is provided below:

   - Christmas Tree: The average acreage of CDL Class 70 (Christmas Trees) for years 2014 – 2018 represented the Christmas Tree UDL.
   - Developed: The average acreage of CDL Classes 122, 123, 124 (Developed/Low Intensity, Developed/Med Intensity, and Developed/High Intensity) for years 2014 – 2018 represented the Developed UDL.
   - Open Space Developed: The average acreage of CDL Classes 121 (Developed/Open Space) for years 2014 – 2018 represented the Open Space Developed UDL.
   - Field Nurseries: Only the CDL-based component to the Field Nurseries UDL was included, as the Dun & Bradstreet dataset of nursery point locations was unavailable. An average of the CDL Classes associated with Citrus and Other Orchards UDLs as defined in Table 2 of Appendix 1-5 of the BE for years 2014 – 2018. These two UDLs include 17 different tree crop classes (Cherries, Peaches, Apples, Other Tree Crops, Citrus, Pecans, Almonds, Walnuts, Pears, Pistachios, Prunes, Olives, Oranges, Pomegranates, Nectarines, Plums, and Apricots).
   - Managed Forest: The data sources and process described in Section 4.2 of Appendix 1-6 was followed to generate this UDL, representative of one year.

- Poultry Litter: The data sources and process described in Section 4.2 of Appendix 1-6 was generally followed to generate this UDL. A composite of the nine UDLs associated with potential poultry litter applications (corn, soybeans, other grains, cotton, wheat, rice, other row crops, vegetables and ground fruit, and alfalfa) were generated from CDL for each of the years from 2014 – 2018. Next, the 2017 Census of Agriculture was queried to identify counties with poultry operations. The five years of composite UDLs were then extracted for those counties associated with poultry operations. The total acreage over the CONUS was then averaged over the five years.

A summary of these acreages is provided in Table 3-3 below. As seen in the table, these acreages are extensive, including over 46 million acres for Developed, over 63 million acres for Open Space Developed, over 215 million acres for Managed Forest, and over 820 million acres for Poultry Litter. The annual application rates used in the exposure modeling for each neonicotinoid is also provided. Finally, based on the PCT assumptions used in the BE and as input to the MAGtool for each of the UDLs, annual usage is then tabulated. The results were over 446 million pounds of clothianidin usage, over 545 million pounds of imidacloprid usage, and over 32 million pounds of thiamethoxam usage. For comparison, the total Ag plus Non-Ag usage, as reported in the SUUM documents of each BE (Appendix 1-4) and Chapter 1 (Section 4.2) are also reported. An "Overestimation Factor" is then calculated as the ratio of the Non-Ag usage assumed in the MAGtool inputs from the UDL and PCT values compared to the total SUUM usage. The Overestimation Factor is the annual Non-Ag usage assumed based on UDL area and PCT divided by the reported total usage (Ag + Non-Ag) reported in the SUUM and Chapter 1 documents. Thus, the factor is a conservative measure of overestimation as it is calculated relative to agricultural uses in addition to Non-Ag. **These overestimation factors range from 177 for thiamethoxam to 9,927 for clothianidin.**

Table 3-3. Non-Agricultural Neonicotinoid Usage Assumed in BE

Active	*UDL*	*CONUS Area of UDL (acres)*	*Annual Application Rate (lbs/ac)*	*Assumed PCT (%)*	*Annual Usage (lbs)*
Clothianidin	Developed	46,655,421	0.40	100	18,731,266
Clothianidin	Open Space Developed	63,570,386	0.40	100	25,522,303
Clothianidin	Poultry Litter	820,186,025	0.49	100	402,464,481
Clothianidin	**TOTAL**	**930,411,832**			**446,718,051**
Clothianidin	**SUUM Data Ag + Non-Ag Total**				**45,000**
Clothianidin	**Overestimation Factor**[1]				**9,927**

Table 3-3. Non-Agricultural Neonicotinoid Usage Assumed in BE					
Active	*UDL*	*CONUS Area of UDL (acres)*	*Annual Application Rate (lbs/ac)*	*Assumed PCT (%)*	*Annual Usage (lbs)*
Imidacloprid	Christmas Tree	94,099	0.49	100	46,109
Imidacloprid	Developed	46,655,421	0.26	100	12,130,410
Imidacloprid	Open Space Developed	63,570,386	0.50	100	31,785,193
Imidacloprid	Field Nurseries	4,919,219	0.40	100	1,967,687
Imidacloprid	Managed Forest	215,198,563	0.49	100	105,447,296
Imidacloprid	Poultry Litter	820,186,025	0.48	100	393,689,292
Imidacloprid	**TOTAL**	**1,150,623,713**			**545,065,986**
Imidacloprid	**SUUM Data Ag + Non-Ag Total**				**1,308,900**
Imidacloprid	**Overestimation Factor[1]**				**416**
Thiamethoxam	Christmas Tree	94,099	0.24	100	22,332
Thiamethoxam	Developed	46,655,421	0.24	100	11,072,260
Thiamethoxam	Open Space Developed	63,570,386	0.24	100	15,086,517
Thiamethoxam	Field Nurseries	4,919,219	0.24	100	1,167,428
Thiamethoxam	Poultry Litter	820,186,025	0.24	2.5	4,866,161
Thiamethoxam	**Total**	**935,425,150**			**32,214,698**
Thiamethoxam	**SUUM Data Ag + Non-Ag Total**				**182,500**
Thiamethoxam	**Overestimation Factor[1]**				**177**

1.) The Overestimation Factor is the annual Non-Ag usage assumed based on UDL area and PCT divided by the reported total usage (Ag + Non-Ag) reported in the SUUM documents

Recommendation: For all three neonicotinoid BEs, the assessment of the non-agricultural UDLs, including both the spatial extent and PCT assumptions, is highly flawed and leads to erroneous and invalid conclusions regarding the impacts of the non-agricultural use patterns on listed species. The effects determinations must be reconducted using realistic assumptions concerning the amount of neonicotinoid that occurs in association with these use sites. Not surprisingly, the UDLs that were most often predicted to impact species were these non-Ag UDLs. Therefore, a revised and accurate assessment of these UDLs would be expected to substantially alter the findings of the BE.

6. ***The CONUS Co-Occurrence Analysis Results Based the Four Overlay Analysis Methods Applied to All Species Ranges and Critical Habitat Showed Almost no Refinement in Action Area Overlap After Considering PCT:*** Five overlay scenarios were described in Sections 9 and 10 in Appendix 1-7 (EPA, 2021a; EPA, 2021b; EPA 2021c). Four of those five scenarios were applied to all of the species ranges and critical habitats, with the fifth overlap scenario applied to a smaller subset where the species habitats could be refined with spatial datasets. These overlay scenarios were: 1) Unadjusted (no PCT), 2) PCT Overlap, 3) PCT and Redundancy, 4) PCT, Redundancy, Off-site, and 5) PCT, Redundancy, Off-site, Habitat. Here, PCT indicates that one of the PCT scenarios was considered, "Redundancy" indicates that overlapping of individual UDLs was corrected for, "Off-site" indicates that a species was assumed to not occur directly on a use site, and "Habitat" indicates that a species range was refined with land cover/vegetation data based on the species life history. Tables 1 and 2 in Appendix 1-7 provide statistics on the mean and standard deviation of species overlap by UDL and the entire action area for ranges and critical habitat respectively for each of the four scenario methods. These results for the entire action area are replicated in Table 3-4 below.

Table 3-4. Species Range/Critical Habitat Co-Occurrence with Different Overlap Scenarios

Overlap Scenario	*Species Geography*	*Mean CONUS Species Overlay of Action Area (%)*		
		Clothianidin	*Imidacloprid*	*Thiamethoxam*
No Usage	Range	64	75	64
PCT Overlap	Range	64	74	64
PCT and Redundancy	Range	64	74	64
PCT, Redundancy, Off-Site	Range	64	74	64
No Usage	Critical Habitat	24	28	24
PCT Overlap	Critical Habitat	24	28	24
PCT and Redundancy	Critical Habitat	24	28	24
PCT, Redundancy, Off-Site	Critical Habitat	24	28	24

Across the four overlay scenarios shown, the mean overlay percent stays at 64% and 24% for both clothianidin and thiamethoxam for the range and critical habitats respectively. For imidacloprid, the mean overlay drops from 75% to 74% for the species range and stays at 28% for the critical habitats. While some of the individual UDL co-occurrence results show some sensitivity to the overlay scenario refinements, it is remarkable how little refinement occurs in action area overlay percentages after incorporating PCTs by UDL and accounting for UDL redundancy and no habitat on use sites. These results are not supported by actual usage data and do not follow with common sense. This is further strong evidence of the flawed approach for quantifying PCT impacts on species co-occurrence with use sites.

Recommendation: The cause for minimal sensitivity of co-occurrence results to what should be substantial refinements in the overlay methodology should be investigated and remedied. Certainly, much of the insensitivity is due to the inflated PCT values assumed for most UDLs; however, an evaluation that tracks the propagation of usage and PCT assumptions through the different overlay scenarios may provide insight as to which assumptions are driving the unreasonable results.

7. ***The Agricultural PCT Assumptions for Hawaii and Puerto Rico are Overly Conservative in Assuming all Insecticide Usage Represents Each Individual Neonicotinoid:*** The methodology for estimating agricultural usage in the non-lower 48 states (NL48) is described in Appendix 1-8 (EPA, 2021a; EPA, 2021b; EPA 2021c). For Hawaii (HI) and Puerto Rico (PR), the approach used 2012 Census of Agriculture data on acres treated with **ALL** insecticides as a surrogate for acres treated with clothianidin, imidacloprid, or thiamethoxam. Adjustments were made to account for off label crops, however the final PCTs were nonetheless based on all insecticide usage. The resulting PCTs ranged between 13% and 17% for HI and between 8% and 11% for PR.

   Recommendation: The assumption of PCTs based on all insecticides greatly inflates the PCT associated with each individual neonicotinoid active ingredient. An approach for refining these values would be to apply neonicotinoid fractions of all insecticide use from data in the CONUS. This would provide a realistic estimate than the "all" insecticides PCT approach.

8. ***The Assumption of 100% PCT for All Agricultural Uses for the NL48 Regions Outside Hawaii and Puerto Rico is Unrealistic:*** For the NL48 regions with no usage information, including Alaska, Northern Mariana Islands, Guam, American Samoa, and the US Virgin Islands, an agricultural PCT of 100% is assumed. In Alaska, that is scaled by the relative acreage of registered crops, which lowers the PCT for all agricultural land to between 61% and 82%. For the other territories, the 100% PCT is applied to the entire agricultural UDL footprint. In all the NL48 regions, the agricultural use site footprints include all agriculture and do not differentiate spatially between registered and non-registered crops. The compounding conservatism of an extra-large use site footprint and an unrealistic assumption of 100% PCT leads to invalid co-occurrence results for species in the NL48 regions.

   Recommendation: Although neonicotinoid usage survey information is not readily available for the NL48 regions, more realistic assumptions than 100% PCT should be made. Estimates based on CONUS usage and PCTs can serve as a starting point, with consultations with grower groups and/or registrants providing additional valuable insight to help improve the usage and PCT assumptions.

9. ***The Assumption of 100% PCT for Non-Agricultural Uses in All NL48 Regions is Unrealistic:*** The PCTs for the non-agricultural use sites for NL48 regions evaluated in the neonicotinoid BEs were assumed to be 100%. These assumptions were made because no usage data were available for Field Nurseries, Developed, Open Developed, Managed Forests, and Poultry Litter UDLs. This same unfounded assumption was applied to most of the same UDLs in the CONUS, and the magnitude of the over-estimation of usage was quantified (see Table 3-3). Given the more generalized spatial datasets used to represent the non-agricultural potential use sites in the NL48 regions, we expect similar magnitudes of non-agricultural usage overestimation for each neonicotinoid as was calculated for the CONUS.

   Recommendation: Better, more realistic non-agricultural usage assumptions in the NL48 regions must be made. The CONUS analysis also suffered from the poor assumptions of 100% PCT for non-agricultural use sites. Methods must be developed to reasonably constrain usage estimates to much more plausible values in these cases where data is lacking.

10. ***The NL48 Co-Occurrence Analysis Results Based on the Four Overlay Analysis Methods Applied to All Species Ranges and Critical Habitat Showed Almost no Refinement in Action Area Overlap After Considering PCT:*** Five overlay scenarios were described in Sections 8 and 9 in Appendix 1-8 (EPA, 2021a; EPA, 2021b; EPA 2021c). Four of those five scenarios were applied to all the species ranges and critical habitats, with the fifth overlap scenario applied to a smaller subset where the species habitats could be refined with spatial datasets. These overlay scenarios were: 1) Unadjusted (no PCT), 2) PCT Overlap, 3) PCT and Redundancy, 4) PCT, Redundancy, Off-site, and 5) PCT, Redundancy, Off-site, Habitat. Here, PCT indicates that one of the PCT scenarios was considered, "Redundancy" indicates that overlapping of individual UDLs was corrected for, "Off-site" indicates that a species was assumed to not occur directly on a use site, and "Habitat" indicates that a species range was refined with land cover/vegetation data based on the species life history. Tables 3 and 4 in Appendix 1-8 provide statistics on the mean and standard deviation of species overlap by UDL and the entire action area for ranges and critical habitat respectively for each of the four scenario methods. These results for the entire action area are replicated in Table 3-5 below.

Table 3-5. NL48 Species Range/Critical Habitat Co-Occurrence with Different Overlap Scenarios				
Overlap Scenario	***Species Geography***	***Mean NL48 Species Overlay of Action Area (%)***		
		Clothianidin	***Imidacloprid***	***Thiamethoxam***
No Usage	Range	7	36	30
PCT Overlap	Range	7	35	30
PCT and Redundancy	Range	7	35	30
PCT, Redundancy, Off-Site	Range	7	35	30
No Usage	Critical Habitat	0	19	18
PCT Overlap	Critical Habitat	0	19	18
PCT and Redundancy	Critical Habitat	0	19	18
PCT, Redundancy, Off-Site	Critical Habitat	0	<1[1]	18

1. This value of "<1" appears to be an error based on the other overlay percent values reported in the source table

Across the four overlay scenarios shown, the mean range overlay percent stays at 7% for clothianidin, drops from 36% to 35% for imidacloprid, and stays at 30% for thiamethoxam. For critical habitats, the mean overlay percent is 0% across all overlay scenarios for clothianidin, stays at 19% for imidacloprid, and stays at 18% for thiamethoxam. Little if any change in co-occurrence overlay percent was reported for individual UDLs as well. As was observed for the CONUS species ranges and critical habitats, it is remarkable how little refinement occurs in action area overlay percentages after incorporating PCTs by UDL and accounting for UDL redundancy and no habitat on use sites.

Recommendation: The cause lack of co-occurrence results sensitivity to what should be substantial refinements in the overlay methodology is largely a result of the unrealistic PCT assumptions. As discussed in previous points, the derivation of UDLs and methods for estimating PCT will need to be modified to achieve more reason reasonable and realistic co-occurrence results.

4.0 GENERAL COMMENTS ON THE AQUATIC EXPOSURE MODELING APPROACH

4.1 Overview

Aquatic exposure modeling was conducted following the habitat bin approach described in Attachment 3-1 of the clothianidin, imidacloprid, and thiamethoxan BEs (EPA, 2021a; EPA, 2021b; EPA 2021c). The approach considers 10 aquatic habitat bins, including aquatic-associated terrestrial habitats (i.e., wetlands), three sizes of static water bodies, three flowing water bodies with different flow rates, and three estuarine/marine habitats. The exposure modeling associated with these habitat bins is conducted primarily with the PRZM/VVWM models (Young and Fry, 2016; Young, 2016a) which comprise EPA's PWC tool (Young, 2016b). The newly released Plant Assessment Tool, or PAT (EPA, 2020b) is coupled with PRZM/VVWM to simulate wetland habitat. The modeling of aquatic habitat bins has evolved since the first biological evaluations for the organophosphates were released (e.g., chlorpyrifos (EPA, 2017)). The current draft BEs apply the well-established "Farm Pond" scenario to represent medium to large static water habitats (Bin 6 and Bin 7) and some estuarine/marine habitats. The moderate to high flow rate flowing water habitats (Bin 3 and Bin 4) are represented by the Index Reservoir conceptual model and scenarios, while the low flow habitat (Bin 2) and small static water habitats (Bin 5) are represented by edge of field runoff concentrations. The Bin 1 (wetland) habitat is simulated as a shallow depth variation on the Farm Pond scenario. These scenarios were simulated using screening level parameterization approaches. While the MAGtool provides the option for probabilistic sampling of some aquatic exposure model input factors (application date and runoff curve number), it is unclear why this options was not exercised for all species in the draft neonicotinoid BEs, particularly given the NRC recommendation to apply probabilistic methods (NRC, 2013).

4.2 Critique of Methodology and Recommendations

The aquatic exposure modeling conducted in the draft neonicotinoid BEs used established EPA regulatory exposure modeling scenarios to represent a wide range of aquatic habitat, with a few relatively new approaches (edge of field and wetland) to represent some habitats. We have identified several aspects of the modeling approach implemented in the draft BEs that could be improved to better represent some types of aquatic habitat, as well as to produce more refined exposure distributions relevant to individual species ranges and critical habitat. Direct incorporation of neonicotinoid usage data to refine exposure magnitude predictions is also discussed.

1. ***The Edge of Field EECs Used to Represent Bin 2 Water Bodies Do Not Appropriately Represent Bin 2 Habitat:*** Typical "low flow" flowing water bodies and headwater streams that can sustain aquatic life maintain a minimum amount of water required for the organisms to survive. In addition, by definition, flowing water bodies have consistent flow, comprised of a "baseflow" portion, typically sustained by subsurface flow, and a "stormflow" component that increases during runoff events. The edge-of-field concentrations from PRZM were used to represent EECs in the Bin 2 (low flow) habitats. This is inappropriate for a few key reasons. First, the constant water volume and baseflow aspects of a low flow habitat are ignored. Second, flowing water bodies are often drained by more than one field, and include non-cultivated areas such as roads, developed land,

riparian areas, and forests. A heterogeneous landscape is not accounted for in edge-of-field concentrations.

Recommendation: A flowing water and watershed model should be developed for assessing different configurations of Bin 2 flowing water bodies. The model should account for minimum flow requirements for the species in establishing baseflow for the water body and allow a tiered approach for refining the fraction of treated areas draining to the water body.

2. ***The Edge of Field EECs Used to Represent Bin 5 Water Bodies Do Not Appropriately Represent Bin 5 Habitat:*** Bin 5 water bodies, low volume static water habitat, are intended to represent water bodies up to 100 m^3 in volume and include vernal pools, small ponds, off-channel floodplain pools, and seasonal wetlands. These types of water bodies are dynamic from both a volume standpoint and a surface area standpoint. Furthermore, they may only support aquatic life for portions of the year where a minimum depth or volume threshold is met. The edge-of-field runoff concentrations used to represent this type of habitat are very episodic and do not consider pesticide dynamics in a receiving water body, and thus do not reflect the time-variable trends of pesticide dynamics in a small aquatic habitat. Dilution with water within the habitat and aquatic and benthic degradation processes are not considered.

   Recommendation: A variable volume static water body, similar to the wetland habitat conceptual model used in PAT, could be designed and serve as a reasonable screening level model for Bin 5 habitat. The water body could be simulated using VVWM, with variable volume and flow-through enabled, with a minimum threshold depth set for evaluating EECs (like PAT, which is set at 0.5 cm). The maximum water body depth and volume should be set at values across the range of depths/volumes covered by the Bin 5 habitat definition, particularly in the Step 2 Monte Carlo analysis implemented through the MAGtool where EECs are drawn probabilistically. The portion of a field draining into this habitat would be set based on the length of the field and the width of the water body, assuming sheet flow coming off the field.

3. ***Use of the Index Reservoir for Bin 3 and Bin 4 Water Bodies Does Not Account for Important Watershed Processes Applicable to these Flowing Water Habitats:*** The aquatic exposure modeling for moderate (1 m^3/s – 100 m^3/s) and high flow (> 100 m^3/s) water bodies was based on the Index Reservoir scenario. The Index Reservoir scenario, used for surface drinking water assessments, represents a high vulnerability and semi-static small reservoir, and associated 172.8 ha watershed. Hydrologically, the Index Reservoir is very different than a free-flowing river. In a free-flowing river, pesticide residence time in a river segment will be much shorter than in a reservoir, so peak

concentrations will be short-lived, and EECs averaged over longer durations will be reduced. From a landscape perspective, larger watersheds contributing to rivers and streams flowing at rates of 1 m^3/s to 100 m^3/s and higher will have substantial environmental and agronomic variability impacting the transport of pesticides to the receiving water body.

The watershed sizes associated with flowing water bodies between 1 m^3/s and 100 m^3/s are significantly larger than the Index Reservoir. In the EPA's BE for chlorpyrifos (EPA, 2017), they estimated watershed areas associated with these flow rates at the HUC2 scale. Looking across the CONUS HUC2s (1 – 18), the watershed areas associated with flow at 1 m^3/s ranged between 4,700 ha and 805,000 ha (median of 16,550 ha). The watershed areas associated with flow at 100 m^3/s ranged between 461,000 ha and 812,000,000 ha (median of 4,195,000 ha). Watersheds of these size (several orders of magnitude larger in size than the Index Reservoir), have substantial heterogeneity in runoff and transport processes, variability in pesticide usage (amounts, application practices, and application timing), and exhibit dampening and dispersion in chemograph peaks associated with variable travel times and attenuation. These factors are not accounted for in the Index Reservoir conceptual model applied in the neonicotinoid BEs.

Recommendation: A watershed scale model, capable of representing the heterogeneity in landscape characteristics, environmental processes, and agronomic practices should be developed and implemented for the evaluation of exposure in the moderate and high flow habitat bins (Bin 3 and Bin 4). At Step 2 in the BE process, the implementation of this modeling approach should account for the heterogeneities described above, as well as usage data-based estimates of PCT at the crop group (UDL) level. One candidate model capable of these watershed-scale predictions is the Soil and Water Assessment Tool (SWAT) (Gassman et al., 2014). The SWAT model has been shown to accurately predict annual maximum pesticide concentrations in flowing water bodies, even without calibration in more difficult to predict headwater streams (Winchell et al., 2018).

4. ***For All Aquatic Bins, the EECs Do Not Account for Application Timing Variability, PCA variability, Use Pattern Variability, and Actual Usage (PCT):*** The aquatic EECs for all habitat bins assume synchronous applications within a watershed, 100% PCA, and 100% PCT. While the use pattern for the neonicotinoids encompass numerous crops and non-agricultural areas within the US, the use patterns and timing of applications is variable, and combinations of different land cover and crops within a watershed (from a small pond watershed to a large river watershed) varies as well. The actual PCT for different potential use sites, when correctly calculated, also varies substantially across the relevant neonicotinoid UDLs. All these factors can be accounted for in parameterizing watersheds associated with all the aquatic habitat bins.

Recommendation: A modeling approach for aquatic habitat that accounts for application timing variability, PCA variability, and PCT variability should be implemented in the Step 2 probabilistic aquatic exposure modeling. For medium and large static water bodies (Bin 6 and Bin 7), water bodies can be identified within a given species range and watersheds associated with each water body estimated. The proportions of different UDLs within these pond watersheds, with variable application timing including treated and untreated portions, can be calculated and exposure simulations generated for each water body. This same approach can be applied to each of the flowing water habitat bins, using different sized watersheds to characterize the inputs to low, moderate, and high flow habitats. Example watershed sizes could include NHDPlus catchments to HUC12 watersheds for low flow habitats, and HUC12 watersheds to aggregations of HUC12 watersheds for moderate to high flow habitats. This type of modeling approach allows for exposure simulations to be generated based upon water bodies and their watersheds found specifically within a species range or critical habitat. The explicit inclusion of PCT in exposure modeling will ensure that predictions are congruent with neonicotinoid concentrations observed in the environment. This increases the defensibility and relevance of the exposure magnitudes associated with each species.

5. ***The Spatial Resolution of Exposure Scenarios at the HUC2 Scale is Insufficient to Characterize Species-Specific Exposure:*** In the neonicotinoid aquatic exposure modeling, a single PRZM landscape scenario per crop group, and either one or two weather stations, are selected to represent exposure in each HUC2. Because of their large size, HUC2 watersheds cover very diverse climatological regions (see Figure 4-1) adopted from Attachment 3-1(EPA, 2021a). Particularly in the western CONUS HUC2s, a species range may be constrained to drier or wetter portions of the HUC2. As rainfall is one of the most important parameters required to estimate aquatic exposure magnitude, it is important that climate inputs to PRZM simulations reflect that of a species range or critical habitat.

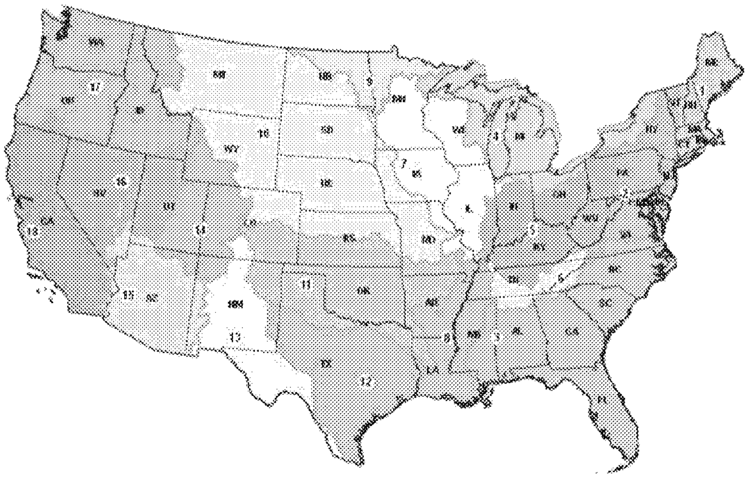


Figure 4-1. HUC2 Watersheds Used to Group Aquatic Exposure Scenarios

Recommendation: The HUC2 resolution of representative PRZM landscape scenarios, coupled with the Step 2 Monte Carlo sampling of runoff curve numbers in the MAGtool, may be sufficient for capturing exposure variability based on landscape characteristics. However, we recommend that the density of weather stations be increased to the HUC10 watershed scale, with weather stations from whatever network chosen (e.g., SAMSON or new EPA weather station network) assigned to each HUC10. Species ranges and critical habitats can then be intersected with HUC10 watersheds to determine which weather stations are relevant to each species. This approach should improve the species specificity of exposure predictions.

6. ***The Drift Fraction Assumptions for Aquatic Modeling are all Based on Edge-of-Field and are Overly Conservative:*** The drift inputs to aquatic habitat simulations with VVWM were all modeled assuming the use site was immediately adjacent to the water body, or in the case of imidacloprid, at the minimum spray buffer setback distance from the water body. Aquatic habitats are often set back away from application sites, sometimes substantially, reducing potential drift inputs. Proximity distances from aquatic habitat locations to the individual neonicotinoid UDLs can be calculated using geospatial processing methods. A probability distribution of proximity distances could be translated to drift fraction variability and incorporated into the probabilistic exposure modeling using the MAGtool in Step 2.

Recommendation: The variability in the proximity of use site applications to receiving waters should be incorporated into quantifying drift inputs to aquatic habitat bin exposure modeling. The proximity distributions should be species range/critical habitat specific and conducted for each UDL. Further refinement could be conducted at the habitat bin level (such as differentiating static ponds and flowing water bodies). This would refine drift contribution to exposure in all habitat bins, including the wetland water body assessed in PAT.

7. ***Drift Contributions to Aquatic Exposure are Based on Conservative Drift Curves and Transport Assumptions:*** The spray drift contributions to aquatic exposure were based on conservative AgDRIFT Tier 1 models for ground boom and aerial spray. The ground model represents the most conservative Tier 1 model, consisting of the 90th percentile curve for high boom and very fine to fine droplets. For aerial, the fine to medium droplet size was assumed. In practice, neonicotinoids are often applied with medium droplet size or coarser, and this practice is required on many current labels. The coarser droplet sizes would reduce downwind transport of spray droplets to potential receiving water bodies. In addition, the drift curves assume high-end wind speeds (10 mph of greater), assume the wind is always blowing perpendicular to the field, and that water body is always located downwind of the application site. Furthermore, the modeled drift curves are based on bare soil conditions and do not account for the vegetation that may intercept the spray droplets before they have the chance to impact a water body. These factors all lead to an over-prediction of expected spray drift contributions to exposure. A recent field study looking at the effect of nozzle selection on deposition is available (Perine et al. 2021) and supports the fact that field derived models predict shorter mitigation distances than the AgDRIFT model.

   Recommendation: Drift curves based on typical agronomic practices, including recommended droplet size, should be incorporated into the BEs to realistically reflect off-site transport and potential exposure due to spray drift. While this comment is provided in the context of aquatic modeling, it is equally if not more relevant to terrestrial exposure, where spray drift is often the primary off-site transport mechanism. Further refinement beyond AgDRIFT Tier 1 curves could be pursued based on more detailed specifications concerning droplet size distribution, maximum boom height, acceptable meteorological conditions, and aerial spray practices associated with neonicotinoid applications.

8. ***The Residential Scenarios for each of the Neonicotinoid BEs Incorrectly Assume the Entire House Lot is Treated with Insecticide:*** Chapter 3 of the BEs discusses the scenarios chosen for simulating non-agricultural uses, including residential uses. In each BE, the "ResidentialESA" scenarios were used, with the assumption that 100% of the house lot is treated with the respective neonicotinoid. While it is true that each neonicotinoid has multiple different residential use sites described on their labels, it is not possible for the entirety of each house lot to be treated. Areas such as the house footprint itself cannot be treated. In addition, impervious areas such as driveways and sidewalks

are not listed as use sites for any of the neonicotinoids. For the remaining landscape units on a residential lot, it remains highly implausible that 100% of those areas would be treated. Thus, the resulting application mass per house lot is inflated, leading to over-prediction of aquatic EECs.

Recommendation: A careful assessment of the use sites specifically identified on each label should be conducted and treated area fractions of a typical house lot estimated. In addition, the Residential Exposure Joint Venture (REJV) database provides a wealth of information concerning outdoor residential pesticide usage (REJV, 2014), which could be used to better quantify actual residential application practices of homeowners, including treated use site of neonicotinoids.

5.0 PLANT ASSESSMENT TOOL

The Plant Assessment Tool (PAT) (EPA, 2020b) is a mechanistic model written in Python that estimates pesticide concentrations in terrestrial, wetland, and aquatic plant habitats. It is comprised of three modules representing each of these environments. Each of the modules generates estimated environmental concentrations (EECs). The comments below are focused towards the terrestrial and wetland conceptual models and their technical implementation.

5.1 Terrestrial Plant Exposure Zone (T-PEZ) Conceptual Model

5.1.1 Overview

The Terrestrial Plant Exposure Zone (T-PEZ) conceptual model is intended to represent a non-target terrestrial (non-inundated) plant community immediately adjacent to a treated field that is exposed to pesticide via spray drift and runoff. Runoff is assumed to move through the exposure zone as a continuous film of non-channelized water. The vegetation zone itself may consist of various plants and may include trees, shrubs, grasses, and forbs.

T-PEZ modeling algorithms account for the pesticide loading to the non-target area via transport by runoff, erosion, and spray drift. Runoff, erosion, and their pesticide loadings are read from Pesticide Root Zone Model (PRZM) output files (*.zts files) and spray drift is modeled using AgDRIFT Tier 1 or user defined deposition curves. According to the manual, the model uses a mixing cell approach to represent water within the active root zone area of soil, and accounts for flow through the T-PEZ caused by both treated field runoff and direct precipitation onto the T-PEZ. Pesticide losses from the T-PEZ occur from degradation as well as washout and infiltration below the active root zone. Figure 5-1 (copied from the PAT manual) illustrates the general T-PEZ model mechanics.

The T-PEZ is defined as an area immediately adjacent to the treated field with a length of 316 m (equal to the length of the edge of the treated field), and a width of 30 m (see Figure 5-1). According to the PAT manual, the width of the T-PEZ represents the distance that overland surface flow can travel before sheet flow transitions to concentrated flow. This means that the width of the exposure zone represents the edge of habitats immediately adjacent to a treated field for which runoff sheet flow and retention within the terrestrial plant community is of concern.

PAT accounts for chemical loading from runoff, eroded sediment, and, where appropriate, spray drift. In the T-PEZ, the contribution from spray drift deposition onto foliage is integrated over 1 m sections oriented parallel to the edge of the treated field. This direct foliar exposure is combined with the T-PEZ runoff-based soil mixing cell exposures to generate plant exposures that are calculated for every 1 m interval over the 30-m width of the T-PEZ. According to the manual, exposure, and risk to terrestrial vegetation beyond the 30-m T-PEZ boundary only considers spray drift foliar deposition (based upon AgDRIFT Tier I or custom deposition curves), which contradicts other parts of the manual stating that the T-PEZ is defined as an area immediately adjacent to a treated field.

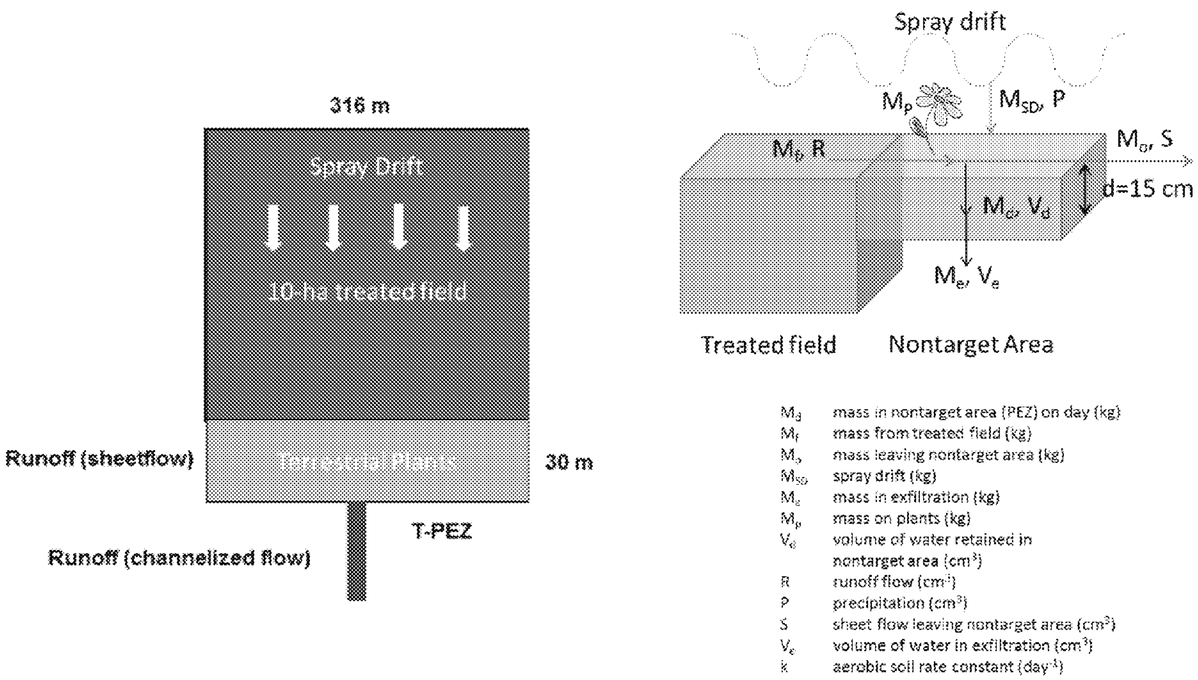


Figure 5-1. Terrestrial Plant Exposure Zone (T-PEZ) Conceptual Model (aerial view of treated field and adjacent T-PEZ and generalized model illustrating the T-PEZ components; see Figure 2 in PAT manual).

5.1.2 Critique and Recommendations

The Plant Assessment Tool (PAT) is used to estimate exposures to plants in terrestrial habitats in the draft neonicotinoid BEs. Thus, the PAT results were a critical component in the analysis plans and had a significant impact in making NLAA/LAA decisions. A critique of the terrestrial plant exposure zone conceptual model and their potential impacts on the outcome of the effect determinations in the draft BEs are listed below.

1. ***The Terrestrial Module of PAT is a New Tool Designed to Refine Screening-Level Exposure Estimates and Has Not Been Thoroughly Reviewed:*** PAT uses its own set of algorithms to simulate pesticide transport and fate. The manual indicates that the algorithms are based on the equations used by PRZM. At a minimum, the PRZM algorithms were translated from Fortran to Python with some modifications to account for specifics of the T-PEZ conceptual model. Even if the fate and transport equations are well understood and sufficiently coded in Fortran, the modifications required for the T-PEZ conceptual model and for translating them to Python code are significant and prone to potential errors.

   Recommendation: PAT and especially the terrestrial module should go through a Science Advisory Panel (SAP) review. In addition, the scientific community and all stakeholders should get the opportunity to review and test PAT before it is being used in Biological Evaluation supported by the EPA. Conference/workshop presentations are inadequate to validate the scientific integrity of a new model.

2. ***The T-PEZ Conceptual Model Assumes That All Runoff from the Field Enters the T-PEZ as Sheet Flow and Does Not Account for Many Site-Specific Factors Which Have an Impact on the Occurrence of Runoff into the T-PEZ*:** The terrestrial module assumes that the T-PEZ is always immediately adjacent to a treated field, which is exposed to pesticide via sheet flow and spray drift from the treated field. The PAT manual states on page 7 to 8: "An evaluation of available literature indicates that the distance sheet flow travels before becoming concentrated flow varies depending on roughness and slope of the landscape, with flow lengths ranging from 4 to 100 m but typically between 15 and 30 m." Based on the literature review, it is unreasonable to assume that all runoff from a field enters the T-PEZ as sheet flow. As acknowledged in the uncertainty section of the PAT manual, there are many different factors (e.g., slope, surface roughness, flow path length) influencing runoff into the T-PEZ. These factors may vary greatly between different application sites (e.g., row crops, vegetables, orchards, hay, pasture). PAT does not account for site specific characteristics and field management practices (e.g., terracing, contour farming, runoff and erosion controls, irrigation/drainage ditches, rills, and creeks) which may result in less opportunity for 100% sheet flow runoff into the T-

PEZ.

Recommendation: The T-PEZ conceptual module should acknowledge that the fraction of sheet and channelized flow changes depending on site-specific characteristics. It is not appropriate to always assume that runoff from a field enters the T-PEZ as sheet flow and is maintained as sheet flow through the 30 m terrestrial vegetation community. The following changes to the T-PEZ conceptual model are needed: (1) The fraction of flow entering the T-PEZ as sheet flow needs to be an input parameter. (2) PRZM scenario specific sheet flow fractions need to be developed. This would lead to some fraction of "bypass" channelized flow moving past/through the T-PEZ.

3. ***The Manual has Contradictory Statements Regarding the Location of the T-PEZ Relative to a Treated Field and the Buffer / Setback PAT Input Parameter has No Impact on Runoff Loadings:*** The manual (Section 3.1) states: "This module is intended to represent a non-target terrestrial (non-inundated) plant community immediately adjacent to a treated field, which is exposed to pesticide via sheet flow and spray drift from the treated field." The same section contradictory states: "Exposure and risk to terrestrial dry-land vegetation beyond the 30-m T-PEZ boundary only consider spray drift foliar deposition (based upon AgDRIFT Tier I or custom deposition curves)." Based on the two statements cited above, it is not clear whether the T-PEZ is always assumed to be immediately adjacent to a field or if there can be a buffer between the treated field and the exposure zone. The module includes a 'buffer_setback' input parameter indicating that the latter is the case. This 'buffer_setback' parameter has an impact on drift loadings but is non-sensitive to the estimated runoff loadings. The PAT manual states on page 7 to 8: "An evaluation of available literature indicates that the distance sheet flow travels before becoming concentrated flow varies depending on roughness and slope of the landscape, with flow lengths ranging from 4 to 100 m but typically between 15 and 30 m."

   Recommendation: The manual should be revised, and the contradictory statements removed and clarified. The 'buffer_setback' parameter should have an impact on the fraction of flow entering the T-PEZ as sheet flow. As the 'buffer_setback' increases the fraction of sheet flow entering the T-PEZ should decrease (a larger fraction of the runoff loadings would infiltrate before reaching the T-PEZ and another fraction would by-pass the T-PEZ as channelized flow without interacting with the terrestrial plants). At a minimum, the 'buffer_setback' parameter should acknowledge that there is no sheet flow beyond a 30 m travel distance to be consistent with the statements in the manual and the methods used in the neonicotinoid BEs.

4. ***The Water Balance and Run-Off / Infiltration Calculations Are Overly Simplistic:*** According to the manual, the daily T-PEZ water balance can be expressed as

$$R_i + P_i = I_i + Q_i + \theta_i V_{TPEZ} \qquad \text{(Equation 1)}$$

where i is the current day, R_i is the runoff from treated field (m^3), P_i is the precipitation onto the T-PEZ (m^3), Q_i is the runoff out of the T-PEZ (m3), I_i is the volume leaching below the root zone (m^3), and $\theta_i V_{TPEZ}$ is the available water capacity in the T-PEZ (m^3). In the last term θ represents the volumetric soil water content of the soil (m^3/m^3) and V_{TPEZ} is the volume of the T-PEZ (m^3). It should be noted that the description of V_{TPEZ} in the manual is wrong. It is not the volume of the T-PEZ (which would be the product of length (316.228 m), width (30 m), and depth (0.15 m)), instead it is the available water capacity holding potential ((field capacity - wilting point) * volume of the T-PEZ). First, the incoming volume into the T-PEZ is calculated from PRZM output ($R_i + P_i$). Next, the amount of water entering ($R_i + P_i$) plus the amount present from the previous day is compared to the field capacity to calculate the volumetric soil water content θ:

- if ($R_i + P_i$) is equal to zero, then θ_i is set to the wilting point,
- if $\frac{R_i+P_i}{V_{TPEZ}} + \theta_{i-1}$ is greater than or equal to field capacity, then θ_i is set to field capacity, and
- if $\frac{R_i+P_i}{V_{TPEZ}} + \theta_{i-1}$ is less than field capacity, then θ_i is set to $\frac{R_i+P_i}{V_{TPEZ}} + \theta_{i-1}$.

The equations above describe how θ_i is calculated. However, as mentioned above, there are inconsistencies between the manual and the code. While the manual uses the T-PEZ volume V_{TPEZ} as the denominator in the comparison terms, the code uses the available water volume ((field capacity - wilting point) V_{TPEZ}), which makes more sense. Finally, the water leaving the T-PEZ (infiltration below the root zone and runoff) is calculated as:

$$I_i + Q_i = R_i + P_i - \theta_i V_{TPEZ} \qquad \text{(Equation 2)}$$

This equation stated in the PAT manual is wrong and should be:

$$I_i + Q_i = R_i + P_i - (\theta_i - \theta_{i-1}) V_{TPEZ} \qquad \text{(Equation 3)}$$

This very simplistic water balance approach is problematic because it assumes that the soil water content is set to the wilting point on all days without precipitation or incoming runoff from the adjacent field, no matter if the soil was at saturation on the previous day.

This results in underestimation of the soil moisture in the first layer and thus leads to a significant underestimation of runoff leaving the T-PEZ. Because of this, plant exposure within the T-PEZ may be over-estimated. In addition, the amount of runoff leaving the T-PEZ is independent from the soil moisture other than the binary behavior described above (runoff and infiltration beyond the root zone occur if the soil is at or above field capacity).

Recommendation: A more realistic water balance algorithm needs to be implemented into the PAT terrestrial module. This algorithm should acknowledge that runoff and infiltration are dependent of soil saturation and many other factors (soil hydraulic conductivity, slope, surface roughness, etc.). In addition, other processes essential to the water balance such as evapotranspiration need to be considered. As an example, the curve number based PRZM algorithm could be used. All necessary inputs are available as PRZM needs to be run prior running PAT. In addition, errors in the manual need to be corrected to be consistent with the code.

5. ***All Pesticide Mass (Soluble and Sorbed) Coming from the Treated Field is Instantaneously Distributed Across the T-PEZ:*** All pesticide mass incoming from the treated field is instantaneously distributed across the T-PEZ (see Section 4.1.3 Pesticide Loadings to the T-PEZ in the PAT manual and Section 4.1.4 Plant Exposure in the T-PEZ) and assumed to 'interact' with the T-PEZ. This is problematic because runoff out of the T-PEZ and infiltration below the T-PEZ active root zone only occur if:

    (a) the incoming water volume exceeds the available T-PEZ holding capacity, which is artificially increased when soil water content is set to wilting point every day without runoff or rainfall inputs or

    (b) the T-PEZ is already at its holding capacity.

In both cases a significant amount of runoff and loadings will 'flush' through the T-PEZ without the potential to interact with the plants. However, due to PAT's simplistic water balance equations, the potential of runoff and loadings 'flushing' through the T-PEZ is artificially decreased. This is caused by unrealistically setting the soil moisture condition to wilting point on all days without rainfall or runoff, without acknowledging soil moisture conditions from the previous time step. Thus, the run-off deposition is highly overestimated in cases where the T-PEZ is already at or close to saturation.

Recommendation: The transport and fate algorithms of the PAT terrestrial module need to be revised. Especially in cases where runoff events occur at a time where the T-PEZ is already at saturation. In those cases, the incoming runoff and their loadings are not expected to interact with the T-PEZ and should not contribute to plant exposure. More specifically, the amount of runoff infiltrating into the T-PEZ needs to be calculated and only the pesticide mass associated with the runoff infiltrating into the T-PEZ should contribute towards the plant exposure. Pesticide loadings that are just flowing over the T-PEZ should not contribute towards terrestrial exposure. With the current approach it is not possible to calculate the amount of runoff infiltrating into the T-PEZ because of the simplistic implementation of the water balance where leaching below the T-PEZ and runoff out of the T-PEZ are calculated in one term. PRZM could be used to solve the hydro-chemical mass balance for a more realistic representation of hydrologic, fate, and transport processes. All model input requirements for this type of approach are readily available, as PZRM simulations are already a required component of PAT.

6. ***All Sediment Is Assumed to Deposit (and Stay) in the T-PEZ:*** All incoming erosion from the treated field is assumed to stay in the T-PEZ. This is unrealistic and overly conservative. Depending on the magnitude of the runoff event and many other parameters (e.g., slope, soil saturation) not all sediment will deposit in the T-PEZ. Thus, a fraction of sediment and sorbed pesticide mass will never interact with the T-PEZ.

   Recommendation: A sediment transport and deposition module needs to be developed that acknowledges that a fraction of sediment and its sorbed pesticide flushes through the T-PEZ. This fraction should not contribute to plant exposure. As suggested above, PRZM could be used as a more realistic landscape mode to calculate the fraction of water that infiltrates. It could then be assumed that the same fraction of erosion is deposited. Alternatively, a mechanistic model such as VFSMOD (Muñoz-Carpena and Parsons, 2004) could be used, or a metamodel based on VFSMOD could be used to estimate sediment and sorbed pesticide deposition in the T-PEZ.

5.2 Wetland Plant Exposure Zone Conceptual Model

5.2.1 Overview

The Wetland Plant Exposure Zone (W-PEZ) conceptual model is intended to represent a non-target wetland plant community that is exposed to pesticide via overland flow and spray drift. The wetland has a variable volume, is allowed to dry out (which leads to concentrating pesticide) and has a maximum volume defined by a maximum water depth of 15 cm. If the incoming and existing water volume exceeds the maximum water depth of 15 cm, flow and washout are assumed to occur, thereby removing some of the pesticide mass. The model excludes comparison of standing water concentrations to aquatic taxa when water depth is less than 0.5 cm. The W-PEZ is defined as a 1 ha wetland receiving inputs from the adjacent 10-ha field (consistent with the conceptual model used for the EPA standard farm pond for aquatic assessments). Within the W-PEZ, two compartments are defined: a standing water zone and a saturated soil pore-water (benthic) zone. The loadings entering the wetland are simulated by PRZM while fate and transport in the waterbody is calculated by VVWM. In VVWM, pesticide movement between the standing water and benthic zones is assumed to occur via a diffusive mass-transfer process. Within the benthic zone, pesticide sorption to sediment is also simulated. Besides washout, pesticide losses from the W-PEZ occur through abiotic and/or biotic degradation. The conversion of VVWM based EECs from per unit volume to per unit area is conducted by summing the pesticide mass in sediment, porewater, and water column across the W-PEZ.

The PAT W-PEZ module is a PWC post-processing tool that (1) filters the PWC water column mass and aquatic concentrations where the water depth is less than 0.5 cm, (2) converts the EECs from per unit volume to per unit area, and (3) compares the EECs to the corresponding aquatic and terrestrial endpoints.

5.2.2 Critique and Recommendations

To estimate exposures to plants in wetland habitats, the draft neonicotinoid BEs use the Plant Assessment Tool (PAT). Thus, the PAT results were a critical component in the neonicotinoid analysis plan and have a significant impact in making NLAA/LAA decisions. A critique of the wetland plant exposure zone conceptual model and its potential impacts on the outcome of the assessment for listed species are provided below.

1. ***The PAT Wetland Module is a New Tool Designed to Refine Screening-Level Exposure Estimates:*** New software often contains bugs and errors when initially released. This was observed in PAT for the T-PEZ calculations.

   Recommendation: A new model or tool should go through an SAP before being used in assessments. The scientific community and all stakeholders should get the opportunity to review and test PAT before it is being used in any risk assessment including the biological evaluations produced by the EPA.

2. ***PAT Converts All Pesticide in Water to a Terrestrial Concentration (lb/A):*** A terrestrial concentration / endpoint does not apply when there is standing water and terrestrial concentrations should only be considered when the water depth is below 0.5 cm (which is the threshold when aquatic concentrations are ignored) (EPA, 2020b).

   Recommendation: The PAT wetland module should only consider terrestrial EECs when the water depth is less than 0.5 cm (and only consider aquatic EECs when the water depth is greater than or equal to 0.5 cm).

3. ***Assuming All Off-Field Runoff and Pesticide Loadings Enter the W-PEZ Is Extremely Conservative for Buffer Distances Greater Than Zero:*** The W-PEZ conceptual model

assumes that all runoff and its loadings from a treated field, which is more than 10 times larger than the wetland itself, enters the wetland water body. While the assumption that 100% runoff and pesticide load from field enters the water body might be a realistic worst-case scenario if the wetland is immediately adjacent to the field, it becomes increasingly unrealistic if there is a buffer (i.e., non-cropped and treated area) between the field and the wetland. Even if there is only a small buffer distance between edge of field and wetland, there will be runoff and pesticide losses due to infiltration and sedimentation (as assumed by the T-PEZ conceptual model) and contributions of flow from untreated areas (i.e., the percent cropped area will be less than 1.0).

Recommendation: The PAT wetland conceptual model is extremely conservative which should be acknowledged in the documentation. For refined simulations, the user should be provided with an option (i.e., an input parameter) to scale the amount of runoff and loadings into the W-PEZ module to a realistic level, accounting for typical Percent Crop Areas (PCAs), reduction in load due to infiltration before reaching the wetland, and Percent Crop Treated (PCT).

5.3 PAT Code Implementation

5.3.1 Overview

For the analysis presented in this report, the PAT version provided with the neonicotinoid draft BE was used. However, it should be noted that currently at least three PAT versions exist which are all available via EPA supported channels. The most recent version is provided with the neonicotinoid draft BE and labeled as PAT 2.1, the version available on EPA's website (https://www.epa.gov/endangered-species/models-and-tools-national-level-listed-species-biological-evaluations-triazine; https://www3.epa.gov/pesticides/nas/models-tools/pat-v2.zip; as of 18 October 2021) is labeled as PAT 2.0, and another version labeled as PAT 2 012420 is available at the EPA-ESA GitHub repository which is unchanged since April 23, 2020 (as of 18 October 2021). It turned out that significant updates were made between the PAT version hosted on GitHub and the PAT version used in the neonicotinoid draft BEs. The manuals provided with all versions refer to PAT version 1.0.

PAT is comprised of three modules representing terrestrial, wetland, and aquatic plant environments. Each of the modules generates estimated environmental concentrations (EECs) and risk quotients (RQs) for terrestrial and aquatic plant toxicity endpoints.

PAT was tested using (1) PWC version 1.52, (2) the drift curves provided in the EPA example data set, and (3) applying various setback distances.

5.3.2 *Critique and Recommendations*

The following comments address the currently available code implementation of PAT provided with the neonicotinoids draft BEs.

1. ***PAT Is Not a Stand-Alone Model:*** In the manual, PAT is described as a stand-alone model that uses existing algorithms from the Pesticide Root Zone Model (PRZM) and the Variable Volume Water Model (VVWM) for EECs in runoff and waterbodies. AgDRIFT is used to calculate off-target spray deposition to areas adjacent to the treated field. All individual components of the model (PWC (PRZM, VVWM), AgDRIFT) have to be setup and run before PAT can be executed. This can lead to user errors because the user has to point PAT to the required individual files (e.g., *.swi (PWC), *.zts (PRZM), *_daily.csv (VVWM)). In addition, PAT uses drift curves exported by AgDRIFT, but the algorithms itself are not used for calculating off-target spray deposition.

   Recommendation: To avoid user errors, PAT should be setup with a minimal set of input files (e.g., *.swi file, drift curves, and toxicity endpoint) and execute PRZM and VVWM. Ideally, PAT could be integrated into PWC.

2. ***PAT Code Documentation:*** PAT is implemented in Python and uses several external libraries (e.g., Pandas and NumPy). For transparency and making results reproducible, the version numbers of the external libraries should be stated.

   Recommendation: The manual and code should include the version numbers of the external libraries used.

3. ***PAT Code Execution:*** As currently implemented, the user is required to make changes to the python code inside the PAT 'main' function for changing inputs and settings. This means that technically the user must change the PAT code for each model run.

   Recommendation: The main PAT function should include all relevant parameters as arguments. This will enable the user to run PAT without having to change the PAT code. In addition, the generation of a truly stand-alone PAT version running without the need of having a Python interpreter and IDE installed should be considered.

4. ***There Is a Conflict Between the Version Number on the Code Provided in EPA-ESA Git-Hub Repository and the Version Number Stated in the Manual:*** The current PAT manual refers to PAT version 1.0. The latest version of the python code, however, indicates that it is version 2.1. The PAT python code itself does not state a version

number but the python code filename is labeled as 'pat v2.1.py'. Some parts of the manual reference the PAT python code as 'pat_v2.py'.

Recommendation: For transparency and reproducibility reasons, the PAT python code and the PAT manual should have matching version numbers with the manual reflecting all changes between versions.

5. ***Several PAT Versions are Distributed Through Official EPA Channels:*** As stated in the beginning of this section, multiple PAT versions with significant differences are available. The version hosted on EPA's official GitHub repository (pat v2 012420) contains a function for calculating spray drift deposition that returns wrong results for most setback distances.

   Recommendation: All official EPA distribution channels should provide the latest version of the code accompanied by a documentation reflecting changes between versions.

6.0 MAGNITUDE OF EFFECT TOOL (MAGTOOL)

The MAGtool is an Excel-based model that reflects the Agency's quantitative implementation of the EPA Revised Method (EPA, 2020a). The Revised Method (EPA, 2020a) represents EPA's most recent approach to conducting national level biological evaluations for pesticides and has been applied to pesticide BE development for the carbamates (carbaryl and methomyl) and herbicides (atrazine, simazine, propazine and glyphosate). The MAGtool was first implemented in the carbamate BEs (carbaryl and methomyl)[7], both of which referenced MAGtool version 2.1 containing the standard EPA screening-level tools including TERRPLANT (terrestrial plant model). The EPA made modifications to the MAGtool for the herbicide BEs (atrazine (EPA, 2020e), simazine (EPA, 2020f), propazine (EPA, 2020g), glyphosate (EPA, 2020h)) and called it MAGtool v2.2. Within v2.2, EPA relaced the TERRPLANT model with the PAT tool, which is a much more complex model for assessing effects to terrestrial, semi-aquatic, and aquatic plants and is discussed in Chapter 5.

There were many errors and issues identified in both MagTool v2.1 and v2.2 and comments were submitted by the various registrants and CropLife America to the BE dockets. A new version, MagTool v 2.3 was released along with the final carbamate BEs. Comments submitted on the carbamate version of the MAGtool point to the many deficiencies in transparency, functionality,

[7] An early version of the MAGtool based on the TED tool was used for malathion but did not reflect the Revised Method approach released by EPA in 2020.

usability, and documentation. For example, from the EPA response to comments on the draft carbaryl BE (EPA, 2021d):

Comment 83: Rotam commented: "The models used include MAGtool (aquatic and terrestrial versions) and Crystal Ball. The user guides provided for both tools lacked adequate descriptions of how to use the models. While physically running the models was possible, there was a lack of transparency in how assumptions were applied to the specific processing steps occurring within the analysis. It was also noted in the BE that there are several parts of the MAGtool no longer functional or used. These areas should be clarified or removed. Some data in the tools were copied and pasted without a clear indication of the source or origin. Much of the information in the tool is not referenced. The usability and transparency of the MAGtool requires additional documentation, a much more detailed user guide, and a removal of obsolete portions of the tool. Additionally, an improved user interface and a training file are needed to validate and verify functionality."

EPA Response: *The MAGtool was developed in Excel and uses visual basic to provide transparency in how assumptions were applied. The MAGtool will continue to evolve as will the associated documentation and BE methodology. In order to keep the tool at a manageable size, some data are copied and pasted without the links to where they were derived. However, as the code is developed using visual basic, a user can evaluate where the data are coming from by stepping through the code. Like all tools, the MAGtool was initially built for functionality, for use in BEs. As methods are revised and updated, tools will be refined and upgraded as necessary.*

For the draft neonicotinoid BEs, the Agency has indicated that the MAGtool v2.3.1 was applied and EPA notes the following in the draft BEs:

"Since the publication of the Revised Methods (EPA, 2020a), modifications were made to the MAGtool and an updated version was used in this analysis (MAGtool version 2.3.1). Updates to the tool incorporated continued efforts to improve the efficiency, accuracy, and refinement of the tool. These updates are outlined more fully in the MAGtool documentation included on the models website and included incorporation of a new batch function analysis, improvements to spray drift analysis methods and input options, as well as the ability to make effects determinations either deterministically or probabilistically. The model allows the user to make deterministic calculations using the upper and lower bounds of the exposure assumptions, or using a probabilistic analysis, to determine impacts to a species based on mortality effects, sublethal effect or effects to prey, pollination, habitat, and dispersal vectors (PPHD). This was done to provide more transparency to the results calculations and to streamline the calculations for shorter run times."

As noted in the following sections, the Agency is still struggling with making the MAGtool a user friendly, transparent, efficient, and scientifically consistent tool for use in BE development. This section discusses transparency issues and quality control which continues to be an issue through all the draft BEs (carbamates, herbicides, and neonicotinoids) to date. Technical/ mechanistic issues that are consistent across the three MAGtools for each of the neonicotinoids are also evaluated along with the incorporation of usage data into the tool.

6.1 Technical/Mechanistic Review and Transparency

Our assumption when downloading the MAGtool from the EPA website for the three neonicotinoids is that once downloaded, the zip file can be opened into an appropriate folder, and all the files including parameter input files for each neonicotinoid are available to run the model. The MAGtool functions within an ecosystem of other tools ranging from spatial (Use Data Layer) data, Visual Basic for Applications (VBA) scripts, Plant Assessment Tool (PAT) inputs, Pesticide Water Calculator (PWC) input files, Oracle Crystal Ball™ and others. Thus, it is a highly complex model and inherently difficult to evaluate, particularly given only the 60-day public comment period for review. Once downloaded, it should be possible to run the MAGtool, and consistently have the tool return the same results documented in the draft BE. We recognize that for a handful of species slight adjustments are made to the MAGtool results to settle on final effect determinations. However, by and large, the results should be comparable. However, this is not the case with the draft neonicotinoid version of the MAGtool.

6.1.1 Technical/Mechanistic Review

There are many technical issues identified in the MAGtool that make it difficult to understand how the tool is applied, how the outputs are treated, and reduce confidence in the model outcomes. Examples are described below.

- It is unclear what the purpose of the automatic function is in the MAGtool batch analysis workbook since EPA selected deterministic analysis for most of the listed species. Based on the MAGtool outputs located in the “Critical Habitat”, “GAP” and “Range” folders in Appendix 4-9 of the draft BE for clothianidin, EPA has selected “1-Deterministic” analysis for most of the listed species in the MAGtool batch analysis workbook. The only instance where probabilistic analysis was used in the draft clothianidin BE was for four aquatic species (i.e., Moapa dace (*Moapa coriacea*; Entity ID: 211), Gila topminnow (*Poeciliopsis occidentalis*; Entity ID: 219), Cave crayfish (*Cambarus zophonastes*; Entity ID: 488) and Roswell springsnail (*Pyrgulopsis roswellensis*; Entity ID 1246). The MAGtool outputs for these four species can be found in Appendix 4-9 of the draft clothianidin BE in the “clothianidin_Range_Aquatic_Animal_FishAqinvert_PROB” workbook. Similarly, the MAGtool and WoE outputs located in Appendix 4-9 of the draft imidacloprid and thiamethoxam BEs also show that deterministic modeling was selected for most of the listed species except for probabilistic modeling performed on the same four aquatic organisms discussed above. None of the workbooks from these three pesticides had automatic function selected. Since EPA did not use the automatic selection function in their draft BE for these three neonicotinoids it is unclear what the purpose of the auto select function is in the MAGtool batch analysis tool.

Recommendation: Provide information in the user guide or Read Me file that describes when the automatic, deterministic, and probabilistic functions should be used and what the differences in results would be.

- EPA did not appear to use the same input parameters that they provided in the draft BEs. For instance, our MAGtool run for thiamethoxam, for the 40 bird species evaluated in the thiamethoxam BE showed differences in the MAGtool outputs for the adjusted dose-based sublethal endpoint values for all the bird species[8]. The calculations for the adjusted dose based sublethal endpoints are determined in cell T36 of the "TerrRESULTS" worksheet in the "MAG TerrTool v2.3.1" workbook and rely on input parameters for the species body weight, the "MATC or LOAEC" parameter and the weight of the tested animal. These inputs are found within the MAG TerrTool v2.3.1 workbook in the "Min rate doses" worksheet for the species body weight and the "MAGtool inputs" worksheet for the "MATC or LOAEC" parameter and the weight of the tested animal. The reason the adjusted dose based sublethal endpoints are different in the draft thiamethoxam BE is because EPA used 28 g as the weight of the tested animals instead of the 25 g which they provided to the public as the input endpoint. There is no discussion in Chapter 2 of the thiamethoxam BE why the 25 g was selected as the weight of the test animal. Confirmatory calculations of the Excel equations provided in cell T36 of the "TerrRESULTS" worksheet show that once the body weight of the test animal is changed to 28 g then the replicate results become identical to those provided in the draft thiamethoxam BE for the 40 bird species (data not shown). Moreover, the use of the 28 g as the input parameter also addresses the inconsistency observed in birds for the adjusted dietary direct threshold value. The calculations where the bird dietary thresholds are modified takes place in cell T35 of the "TerrRESULTS" worksheet in the MAG TerrTool v2.3.1 workbook and also relies on the "Weight of the test animal" as an input parameter for birds. Changing the weight of the test animal from 25 g (i.e., value provided by EPA) to 28 g also resolved the inconsistencies observed in the replicate analysis for the

[8] The replicate analysis noted differences in all the adjusted dose-based sublethal endpoint values (i.e., presented as "LOAEL or MATC (mg/kg-bw)" in Appendix 4-9 of the draft thiamethoxam BE and located in column AZ of the "MAX Upper CB" worksheet in the "Thiamethoxam Range Terrestrial Animal Birds All" workbook)

adjusted dietary direct threshold value (data not shown). Therefore, EPA did not provide the same input parameters that they used in their assessment.

Recommendation: Clarify and provide justification for the body weight adjustment that supports the results.

- Other inconsistencies noted by the replicate analysis of the bird species in the thiamethoxam BE include selection of different values by the MAGtool workbooks. The MAG TerrTool v2.3.1 workbook selected different values in the "Animal multi species" worksheet for several parameters. These differences including the selection of a different value for the "Type of endpoint" in Step 1 (e.g., draft BE selected "Indirect mortality dietary" but the replicate analysis selected "Indirect sublethal dietary"), selection of the different taxa for Step 2 (e.g., the draft BE selected "Invertebrate diet" but the replicate analysis selected "Arthropods (above ground)"), selection of a different endpoint for the "EEC/endpoint" in Step 2 (e.g., draft BE selected "Aquatic" while the replicate selected "Dietary"), selection of the different value for the most sensitive indirect endpoints in Step 1 and Step 2 (e.g., the draft BE selected 0.007 and 0.05 values, respectively while the replicate analysis selected 0.0014 for both Step 1 and Step 2 analysis), selection of the different "TGAI (Aq only)" endpoint (e.g., draft BE selected 0.05 value while the replicate analysis selected "NA"), selection of the different endpoint type based on indirect sublethal effects (e.g., the draft BE selected the endpoint value of 6900 but the replicate analysis selected 0.32 for the same parameter), the selection of different values for the "Indirect (dose or dietary); dietary only; animals - mort only" parameters (e.g., the draft BE selected the value of 6900 but the replicate analysis selected a value of 0.32 for the same parameter), the presence of values for 13 use layers from the indirect alternative analysis (i.e., the draft BE did not have values based on indirect effects but the replicate analysis did), the differences in drift impacts from indirect applications (e.g., the draft BE did not have drift impact but the replicate analysis did) and the differences in the minimum and maximum total number of individuals impacted from the alternative analysis for indirect effects (e.g., the draft BE did not have values but the replicate analysis did). These inconsistencies are highlighted in Figure 6-1 using Whooping crane (*Grus americana*; Entity ID: 10124) as the example bird species. Examination of the Excel code for the inconsistent parameters indicated that the values displayed in the replicate analysis were referencing the correct cells in the worksheets provided within the MAG TerrTool v2.3.1. workbook. However, since EPA did not use the same values, they provided the general public (e.g., as discussed above the use of 28 g instead of the 25 g as the weight of the tested animals for birds), it is entirely possible that other values were also not provided for public review. It is impossible to find the reason for the difference observed in our replicate analysis without having access to the same MAGtool workbooks EPA used to derive their results. EPA needs to provide the original MAGtool workbooks (e.g., MAG TerrTool, MAG AquaTool etc.) that they used in their analysis for the public to be able to verify that the same input parameters were used and be able to explain inconsistencies observed in the replicate analysis.

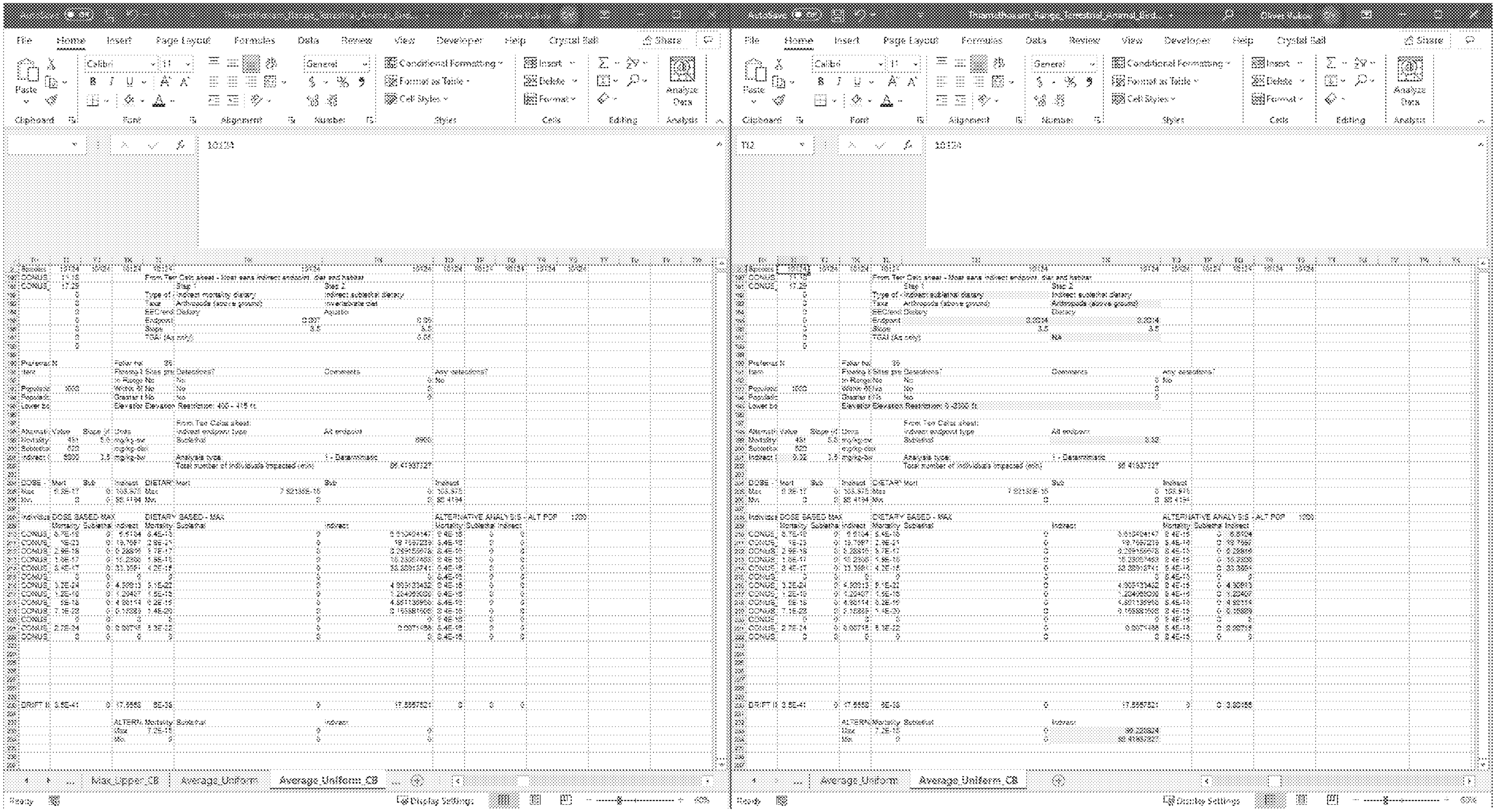


Figure 6-1. MAGtool output comparison of the draft BE (left) and duplicate analysis (right) using the Whooping crane as the example bird species and showing differences in the output values for several parameters from the duplicate analysis (yellow).

- Similarly, EPA needs to provide the CB output template workbooks for each taxon they analyze to be more transparent. The CB output template workbook incorporates the results from the MAG TerrTool or MAG AquaTool and contains Excel code that calculates the effects determination and the strength of call for each species. The CB output template workbook performs calculations for each species (i.e., one species at a time) and exports the finalized results (i.e., species summaries) to the effects determination workbook where all the species that moved on to Step 2 analyses are presented as the final output from the MAGtool analysis. EPA provides the public with the finalized effects determination workbook (i.e., the WoE outputs in Appendix 4-9) but does not provide the CB output template workbook which shows how the determinations were derived. Several inconsistencies have been observed in our replicate analysis that cannot be explained without having access to the same template workbook EPA used during their analysis. For instance, the replicate analysis of aquatic invertebrates analyzed in the draft clothianidin and thiamethoxam BEs shows discrepancy in the species call for the Socorro isopod (*Thermosphaeroma thermophilus*; Entity ID: 483; Table 6-1). In both BEs the effects determinations summaries from the replicate analysis display "Low population NLAA -needs review" and produce values above 0.5 (i.e., but below one) for the maximum number of individuals impacted from mortality, sublethal and indirect effects based on the max upper exposures. However, in the draft clothianidin and thiamethoxam BEs the effects determination for this organism is NLAA and the values for the number of individuals impacted from mortality, sublethal and indirect effects are all set to zero for the max upper exposure scenario. It is unclear how these values were set to zero in the draft BE especially since the outputs from the MAG AquaTool workbook in the replicate analysis are identical to those provided in draft BEs for both chemicals and the values displayed in the replicate analysis appear to originate from this workbook. Since it is impossible to determine the reason for the alteration of values based on the species summary output, EPA needs to provide the CB output template workbook for each analysis for the public reviewers to be able to understand the reasons for the changes.

  Moreover, it is likely that EPA changed the species summaries for the Socorro isopod by manually changing the effects determination to NLAA and altering some of the values to zero. This is supported by the reviewer tab in the species summary for the Socorro isopod which display "Reviewed" in the draft clothianidin and thiamethoxam BEs. The draft BE document discusses the "NLAA with low population" scenario in Attachment 4-1 and state that "If a species with a low population was determined to be NLAA, if no individuals were impacted at the most conservative options and no other qualitative factors were identified that indicated a further evaluation was needed, the determination remained at NLAA". However, reasons for the alterations in the values for mortality, sublethal and indirect effects based on the max upper exposures are not discussed in the draft BEs for both chemicals.

Recommendation: EPA needs to provide the CB output template workbook from each analysis for the public to be able to understand how EPA chose their values and derived their conclusions.

- The reviewer section in the ED output template workbooks indicates that the secondary reviewer always agrees with the effects determination analysis. Figure 6-2 highlights that the secondary reviewer always agrees with the analysis (i.e., cell C55 in the "Output by species" worksheet in the CB output template workbook for terrestrial plants but the same issue was also observed in CB output workbooks responsible for terrestrial animals and aquatic animals). The secondary reviewer assessment is hardcoded in Excel to always "Agree" with the effects determination assessment. The problem has been observed in all the neonic BEs. EPA should explain circumstances when the secondary reviewer does not agree with the effects determination assessment.

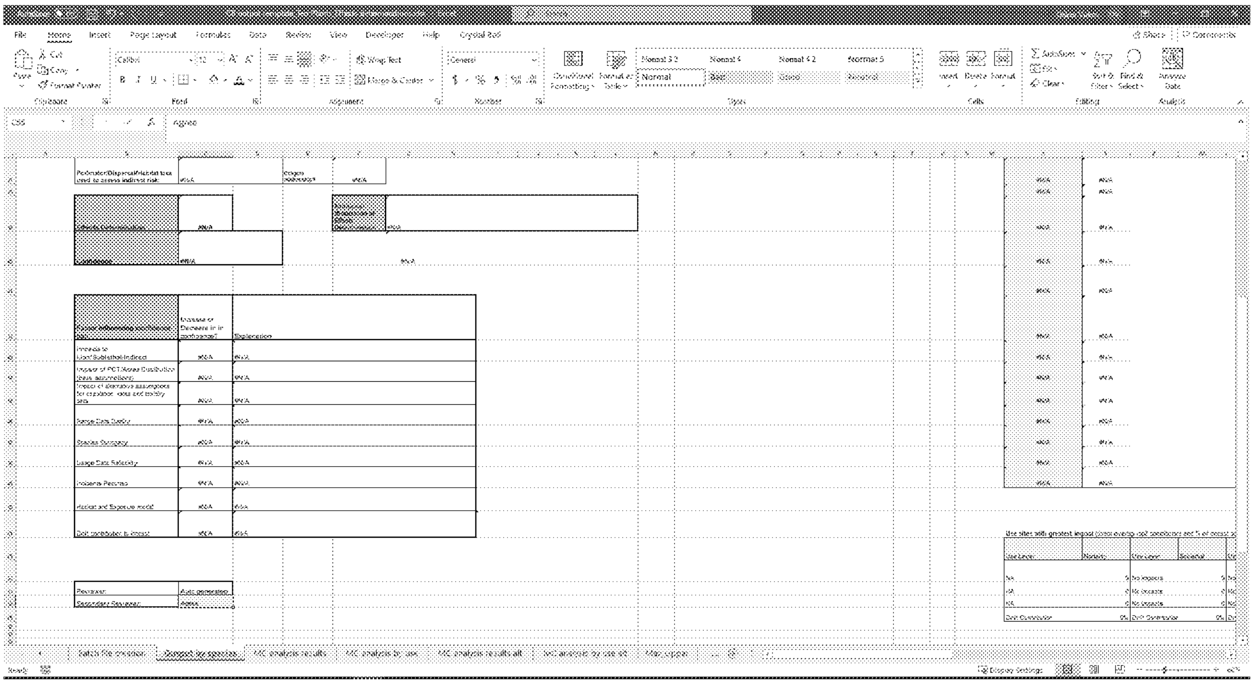


Figure 6-2. The secondary reviewer in the CB output templates workbooks always "Agree" with the effects determination analysis (yellow).

- Inconsistencies were also noted in the MAGtool outputs for all the plant species analyzed in Group 1 of the imidacloprid BE. The MAG TerrTool v2.3.1 workbook from the replicate analysis consistently produced different values in the "Plant multi species" worksheet for several parameters and these inconsistencies affected all the 86 plant species in Group1. Using the Ashy dogweed (*Thymophylla tephroleuca*; Entity ID 615) as the example plant species and the average uniform exposure scenario the replicate analysis calculated lower spray drift values for direct and indirect effects (i.e., the spray drift outputs in the draft BE were approximately 21.2 times higher than the replicate analysis) and this inconsistency appeared to also affect the "Drift overlap AA based on indirect effects" (i.e., CONUS Other crops usage layer for the state of Texas) and the indirect drift impacts values (i.e., both were 21.2 times higher in the draft BE). These differences in outputs have also affected the minimum and maximum number of individuals affected and the maximum number of individuals impacted by the alternative analysis (e.g., the draft BE produced at least seven times higher values). For the Ashy dogweed, it appears that the cause of the discrepancy stems from cells LT1777:MD1777 located in the "Drift usage adjusted state plant" worksheet in the MAG TerrTool v2.3.1 workbook. These cells contain Excel formulas that are responsible for adjusting the drift values from 0 to 810 m (i.e., hardcoded in cells F1777:IA1777) and consider other factors such as the acres distribution of imidacloprid, several PCT adjustments and the wind adjustment factor. The Excel coding appears to function correctly. However, it is impossible to determine the exact cause of the discrepancy between our replicate results and those provided in the draft BE without having access to the same workbooks (e.g., MAG TerrTool or MAG AquaTool) EPA used in their analysis. We have shown through the replicate analysis of the 40 bird species in the thiamethoxam BE that EPA did not use the same input values they provided the public and this is also possible for the plant species and imidacloprid.

Recommendation: Stakeholders should be able to duplicate the Agency's analysis with the models provided. When they cannot, it brings into question the validity of the results and how transparent the model approach is. Although there is some additional information provided in the draft BEs (e.g., which species were run probabilistically), it can be difficult to find and interpret. Additional documentation with the MAGtool on idiosyncrasies that would result in different results from what the provided files contain should be provided to facilitate complete duplication of results.

- It appears that the CB output template for aquatic invertebrates is incorrectly referencing the test species used to derive the mortality and sublethal benchmark for snails. For instance, the mortality and sublethal values used to assess snails in the clothianidin BE and the MAGtool analysis were based on toxicity tests performed on the Eastern Oyster (*Crassostrea virginica*) mollusks. However, the effects determination outputs in the range folder of Appendix 4-9 in the draft clothianidin BE incorrectly state that the benchmarks used to assess mortality and sublethal effects for snails were based on the SSD and the midge, respectively. Figure 6-3 shows the effects determination provided in the draft clothianidin BE using the Tumbling creek cavesnail (*Antrobia culveri*; Entity ID: 406) as the example organisms. The cause of the problem occurs in the "WoE Information" worksheet within the aquatic invertebrates CB Output template workbook. In the "WoE Information" worksheet all snail species are incorrectly grouped as "Aquatic Invertebrates" (e.g., see column O labeled "WoE Summary Group") instead of mollusks and this prevents other worksheets to identify Eastern Oyster mollusks as the appropriate test species that was used to compare mortality and sublethal benchmarks to snails. EPA should add "Mollusks" in the WoE Summary Group for all the snail species listed in the "WoE Information" worksheet located in the aquatic invertebrates CB Output template workbook.

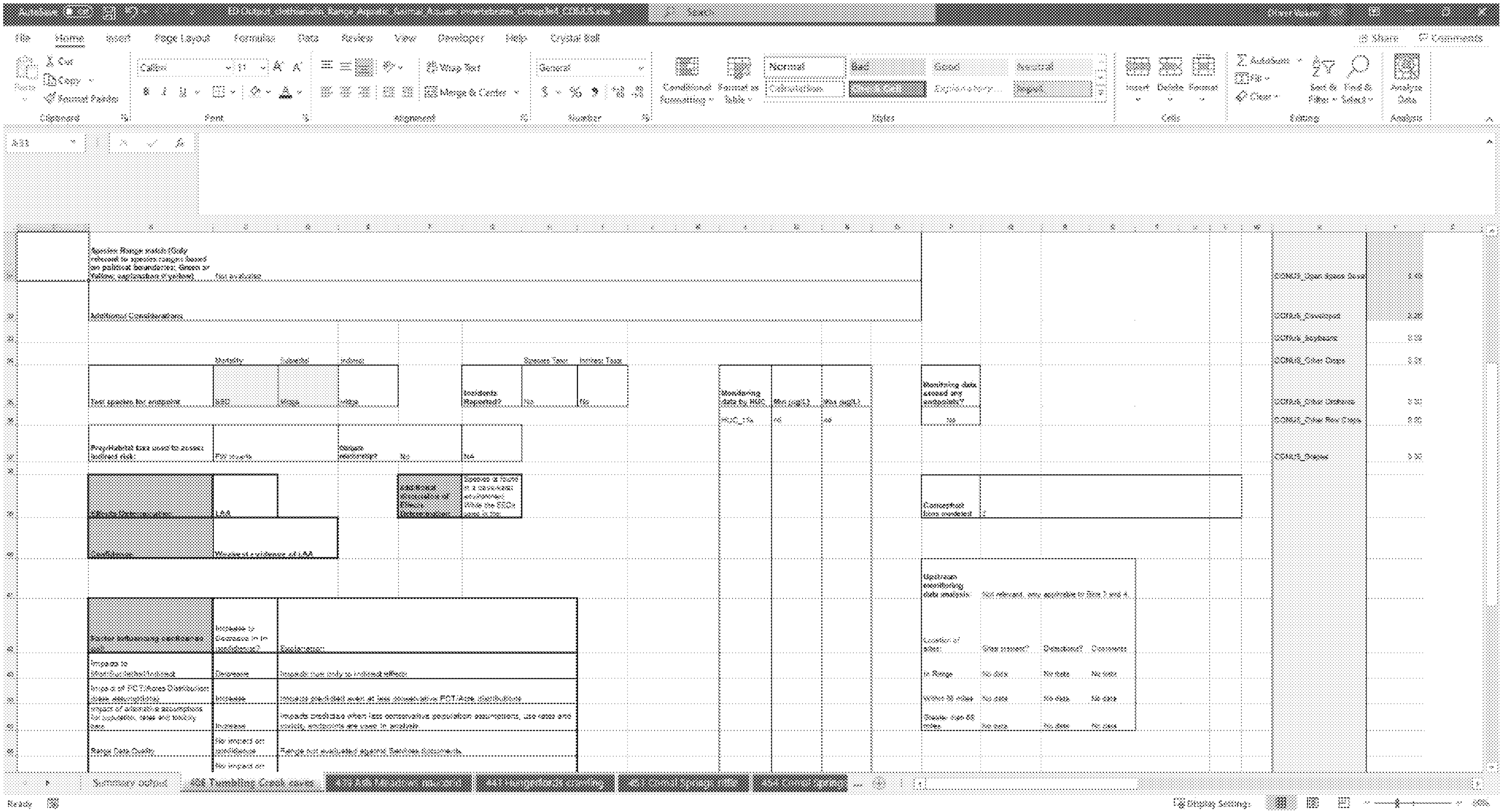


Figure 6-3. The effects determination output in Appendix 4-9 of the draft clothianidin BE is incorrectly selecting SSD and midge as the mortality and sublethal "Test species for endpoint" (Yellow), respectively for the Tumbling creek cavesnail.

- The "elevation restriction" description for all of the bird species listed in "Birds All CONUS" group of the draft clothianidin BE are different than the duplicate analysis. For instance, the description for elevation restriction in the draft clothianidin BE MAGtool output under the Max Upper CB and the Average Uniform CB worksheets for Whooping crane (*Grus americana*; Entity ID 67) indicate that this bird species is restricted to 0-3000 ft. However, the duplicate analysis output for this species indicates that this bird is restricted to 0-3300 ft of elevation. Furthermore, the biological description for this species (or any of the birds listed in the "Birds All CONUS" group) were not found in the "Elevation Restriction" or the "Habitat" worksheets in the MAG_TerrTool_v2.3.1 of the clothianidin MAGtool.

  Moreover, the cell responsible for determining the elevation restriction for all terrestrial animal species is in the MAG_TerrTool_v2.3.1 workbook under the "Animal multi species" worksheets in Cell CU194. The Excel code reads as follows:

  " =IFERROR(@INDEX('Elevation Restriction'!D:D,MATCH('Plant multi species'!BF2,'Elevation Restriction'!A:A,0),),"None") "

  The Excel code in the draft clothianidin BE does not reference the correct bird species instead the habitat restriction information is based on a plant species San Diego thornmint (*Acanthomintha ilicifolia*; Entity ID 496) that is referenced in the "Plant multi species" worksheet. The reason all the bird species in the draft clothianidin BE display 0-3000 ft as their elevation restriction is because this parameter is based on the information provided for San Diego thornmint (e.g., the "Elevation Restriction" worksheet in the MAG_TerrTool_v2.3.1 workbook lists "Elevation Restriction: 0 - 3000 ft." for this plant species) and this is the only plant with this habitat description. Moreover, the error is perpetuated to the effects determination workbooks. For instance, the elevation restrictions are evaluated for each bird species in the WoE analysis in cell Q27:R27 of the "CB output template Terr Animal Effects determinations" workbook before being finalized in the ED Output workbook. The same Excel coding problem has been observed in all the MAGtool workbooks described above for imidacloprid and thiamethoxam. The WoE outputs in Appendix 4-9 of the imidacloprid and thiamethoxam BEs show that the elevation restrictions for birds are "< 1,600 ft", and "400 - 415 ft.", respectively. These restrictions are based on plant species with the same habitat restrictions such as the San Diego ambrosia (*Ambrosia pumila*; Entity ID 500) and the Ashy dogweed (*Thymophylla tephroleuca*); Entity ID 615) that are incorrectly referenced in the imidacloprid and thiamethoxam BEs, respectively.

  Therefore, it is not clear how the elevation data was applied in all three neonicotinoid BEs. This is particularly true since the elevation restrictions for all the listed birds were absent from the "Elevation Restriction" or "Habitat" worksheets in the

MAG_TerrTool_v2.3.1 workbook and the elevation restrictions were based on information provided for plant species.

Recommendation: It is not entirely clear how the elevation data are being used in the MAGtool and why the elevation restrictions are limited to the three species of plants mentioned. This speaks to the transparency of the tool and the need for clearer information on the approaches taken.

- The dietary based exposure concentrations in the clothianidin MAGtool for dietary items are incorrectly referenced in other worksheets provided in the MAG_TerrTool_v2.3.1 workbook. The dietary based exposure concentrations are calculated in the "Min rate dose" worksheet located in the MAG_TerrTool_v2.3.1 workbook, however, these values are incorrectly referenced in other worksheets. For instance, using the Whooping crane (*Grus americana*, Entity ID 10124) as the target bird species and seeds as an example of the dietary item, the dietary exposure concentrations for seeds are calculated in the "Min rate doses" worksheet (i.e., cell J253). However, other worksheets such as the "Animal Step 2 WoE" (i.e., cell X608) and "TerrRESULTS" (i.e., cell J101) incorrectly refer to cell J254 of the "Min rate dose" worksheet. The value referenced in the "Animal Step 2 WoE" and "TerrRESULTS" worksheets correspond to dietary item for benthic invertebrates instead of seeds and for the Yuma clapper rail (*Rallus longirostris yumanensis*, Entity ID 84) bird species instead of the Whooping crane.

  The cause of the incorrect cell reference for the seed dietary item stems from the "Animal Step 2 WoE" worksheet and is caused by the improper use of the Offset function in Excel. The formula in cell X608 of this worksheet reads as follows:

  > " =+IFERROR(IF(OR('Step 3 Animal'!$C$5="Snails",'Step 3 Animal'!$C$5="Insects",'Step 3 Animal'!$C$5="Arachnids"),HLOOKUP(HLOOKUP(X604,'Dietary categories cross'!$A$11:$X$14,4,FALSE),$AP$68:$BD$69,2,FALSE),IF($K$11>7,<u>*OFFSET('Min rate doses'!$A$1,$L$11+7,9)*</u>,"")),"") "

  For the offset function to refer to the correct dietary item (i.e., seeds) the offset portion of the Excel formula in the "Min rate doses" worksheet should be changed to "OFFSET('Min rate doses'!$A$1,$L$11+6,9)".

Moreover, the offset function in the "Step 2 WoE" worksheet appears to correctly reference the first five dietary items provided for the Whooping crane in the "Min rate doses" worksheet but not any subsequent dietary item. For instance, the offset function is correctly referencing the first five dietary items such as amphibians, arthropods, benthic invertebrates, birds, and fish that are consumed by the Whooping crane but is incorrectly referencing the last three dietary items such as fruits, small mammals, and seeds. It appears that the dietary items after the fifth item are incorrectly evaluated in the Animal Step 2 WoE worksheet (i.e., cells V608:AA608) since they suffer from the same Excel offset coding error. Other bird species with more than five dietary items, such as the Guam Micronesian Kingfisher (*Halcyon cinnamomina cinnamomina*; Entity ID 119) (i.e., seven dietary items) and Mississippi sandhill crane (Grus canadensis pulla; Entity ID 110) (i.e., 11 dietary items), have also been tested and show that the offset error occurs after the fifth dietary item. However, bird species that do not exceed five dietary items such as the \`O\`u honeycreeper (*Psittirostra psittacea*; Entity ID 78) (i.e., four items) do not suffer from this Excel coding error. The same issue is present for birds and mammals and is consistent in all of the neonicotinoids MAGtool packages.

Recommendation: The OFFSET error in the neonicotinoid MAGtools must be corrected to ensure the correct dietary items are assigned to the correct Species Entity. With respect to coding practice, we strongly recommend adjusting the equation to remove the OFFSET formulas. It is very difficult to track these and make the appropriate adjustments in any model, particularly one as complex and opaque as the MAGtool.

6.1.2 Case Studies

Further to our assertion that it should be possible to download and run the MAGtool to be able to duplicate EPA's results, the following case studies were undertaken.

6.1.2.1 Native MAGtool Results Duplication

Objective: To duplicate EPA MAGtool results using the provided draft clothianidin, imidacloprid and thiamethoxam MAGtool files and following available guidance.

On September 8th, 2021, the MAGtool zip files for clothianidin, imidacloprid and thiamethoxam were downloaded from the US EPA websites. The packages were extracted in the folder where the zip file was located, and fresh copies of the workbooks were used in the subsequent analysis.

The analysis was performed using Oracle Crystal Ball™ Excel add-in version 11.1.2.4.900 and Office 365 Excel version 2108. The Crystal Ball analysis was optimized for speed by selecting normal speed in the Run Mode settings, suppress chart windows in the Chart Windows settings and the bring Microsoft Excel to the foreground option. Computations were performed on either a Dell Latitude 7400 laptop with an Intel® Core™ i7-8665U processor and 16 GB of physical memory or a Dell Latitude E7450 laptop equipped with an Intel® Core™ i7-5600U vPro processor and 8 GB of physical memory. Both computers ran Windows 10 Pro and the laptop power settings were set to maximum performance.

It should be noted that the laptop computers were dedicated to only performing the MAGtool analysis since previous work on other MAGtool assessments (e.g., atrazine and glyphosate) determined that some differences in outputs between the EPA and the duplicate runs had resulted from the VBA script being interrupted. This is an important point to document in future iterations of the User Guidance documents. Because the VBA script makes extensive use of the cut and paste functionality, the Windows clipboard is regularly filled with MAGtool data that are transferred to other worksheets or workbooks in the MAGtool. If the user attempts to use their computer for other purposes while the MAGtool is running and performs a copy and paste operation in a different application, it can cause errors in the MAGtool as the wrong data from the wrong application end up being copied and pasted.

The MAGtool was run using the same species listed in the draft neonic BE for several different taxa with the goal of duplicating EPA's results. Thus, we did not change any inputs including those that we believe to be incorrect or not scientifically supported. The taxa investigated included terrestrial plants, birds, and aquatic invertebrates from the groups that were used in the draft BEs. The listed species used, and the resulting effects determinations are shown in Tables A1, A2 and A3 in Appendix A for clothianidin, imidacloprid and thiamethoxam, respectively.

The listed species were inputted into the MAGtool Batch Analysis workbook that was provided in the range folder of the extracted package. Deterministic analysis run type was selected in the MAGtool Batch Analysis workbook for each taxon based on what EPA selected in their MAGtool outputs. The instructions provided in the Batch analysis workbook for specific taxa were followed without deviation.

Table 6-1 shows the differences in effects determination outputs between EPA's reported results and our duplicate MAGtool analysis for the three neonicotinoids. Since we followed the same process EPA used (e.g., deterministic evaluation) in our replicate analysis it is puzzling that differences in outputs were observed. As discussed in the transparency section above, there were instances where EPA used different values than the ones provide to the public (e.g., 28 g instead of the 25 g as the weight of the tested animal for birds in the draft thiamethoxam BE) and as such it becomes nearly impossible to determine the reasons for the observed differences in output without access to the same workbooks EPA used during their analysis. EPA needs to provide the same MAGtool and CB output workbooks for each of their analytical runs for the public reviewers to be able to verify that EPA used the same values they provided the public and to be able to efficiently provide explanations for the inconsistencies. This is especially true considering the tight deadline for the public review period.

Table 6-1. Difference in the species call and strength of call resulting from our attempted duplication of results from the native draft clothianidin, imidacloprid and thiamethoxam MAGtool for species ranges										
					EPA Results			***Our Duplicate Results***		
Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Clothianidin										
Aqua. Invert.	*Thermosphaeroma thermophilus*	Group3n4	Socorro isopod	483	Aqua WoE	**NLAA**	NA	Aqua WoE	**Low populat ion NLAA – needs review**	NA
Imidacloprid										
Plants	*Arabis hoffmannii*	Group 1	Hoffmann's rock-cress	501	Terr WoE	**NLAA**	**NA**	Terr WoE	**LAA**	**Moderate evidence of LAA**
Plants	*Berberis pinnata ssp. insularis*	Group 1	Island Barberry	515	Terr WoE	**NLAA**	**NA**	Terr WoE	**LAA**	**Weakest evidence of LAA**
Plants	*Castilleja campestris ssp. succulenta*	Group 1	Fleshy owl's-clover	522	Terr WoE	LAA	**Moderate evidence of LAA**	Terr WoE	LAA	**Weakest evidence of LAA**
Plants	*Eriogonum apricum (incl. var. prostratum)*	Group1	Ione (incl. Irish Hill) buckwheat	547	Terr WoE	LAA	**Moderate evidence of LAA**	Terr WoE	LAA	**Weakest evidence of LAA**
Plants	*Lesquerella thamnophila*	Group1	Zapata bladderpod	569	Terr WoE	LAA	**Moderate evidence of LAA**	Terr WoE	LAA	**Weakest evidence of LAA**
Plants	*Sidalcea oregana ssp. valida*	Group1	Kenwood Marsh checker-mallow	612	Terr WoE	LAA	**Moderate evidence of LAA**	Terr WoE	LAA	**Weakest evidence of LAA**
Plants	*Silene spaldingii*	Group1	Spaldings Catchfly	613	Terr WoE	LAA	**Moderate evidence of LAA**	Terr WoE	LAA	**Weakest evidence of LAA**
Plants	*Thymophylla tephroleuca*	Group1	Ashy dogweed	615	Terr WoE	LAA	**Moderate evidence of LAA**	Terr WoE	LAA	**Weakest evidence of LAA**
Thiamethoxam										
Birds	*Grus americana*	Birds All	Whooping crane	67	Terr WoE	LAA	**Weakest evidence of LAA**	Terr WoE	LAA	**Moderate evidence of LAA**
Birds	*Ammodramus maritimus mirabilis*	Birds All	Cape Sable seaside sparrow	85	Terr WoE	LAA	**Weakest evidence of LAA**	Terr WoE	LAA	**Moderate evidence of LAA**
Birds	*Rallus longirostris obsoletus*	Birds All	California clapper rail	102	Terr WoE	LAA	**Weakest evidence of LAA**	Terr WoE	LAA	**Moderate evidence of LAA**

Table 6-1. Difference in the species call and strength of call resulting from our attempted duplication of results from the native draft clothianidin, imidacloprid and thiamethoxam MAGtool for species ranges										
					EPA Results			***Our Duplicate Results***		
Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Birds	*Grus canadensis pulla*	Birds All	Mississippi sandhill crane	110	Terr WoE	LAA	**Weakest evidence of LAA**	Terr WoE	LAA	**Moderate evidence of LAA**
Birds	*Polyborus plancus audubonii*	Birds All	Audubon's crested caracara	125	Terr WoE	LAA	**Weakest evidence of LAA**	Terr WoE	LAA	**Moderate evidence of LAA**
Birds	*Charadrius melodus*	Birds All	Piping Plover	131	Terr WoE	LAA	**Weakest evidence of LAA**	Terr WoE	LAA	**Moderate evidence of LAA**
Birds	*Grus americana*	Birds All	Whooping crane	4679	Terr WoE	LAA	**Weakest evidence of LAA**	Terr WoE	LAA	**Moderate evidence of LAA**
Birds	*Grus americana*	Birds All	Whooping crane	7342	Terr WoE	LAA	**Weakest evidence of LAA**	Terr WoE	LAA	**Moderate evidence of LAA**
Birds	*Grus americana*	Birds All	Whooping crane	10124	Terr WoE	LAA	**Weakest evidence of LAA**	Terr WoE	LAA	**Moderate evidence of LAA**
Aqua. Invert.	*Thermosphaeroma thermophilus*	Group1-4	Socorro isopod	483	Aqua WoE	**NLAA**	NA	Aqua WoE	**Low population NLAA – needs review**	NA

Aqua. Invert. – Aquatic Invertebrate

Terr WoE – Terrestrial Weight of Evidence

Bold – Difference in output

LAA – Likely to Adverse Affect

NLAA – Not Likely to Adverse Affect

6.1.2.2 Changing Effects determinations to NLAA or NE from LAA

Several MAGtool runs were performed using two terrestrial plant and two terrestrial invertebrate species to understand what alterations were required to change the species call from an LAA to an NLAA or NE determination. The deterministic analysis was selected in the MAGtool Batch analysis tool for species range using two plants (e.g., the monocot Thread-leaved brodiaea (*Brodiaea filifolia*; Entity ID 416) and the dicot San Diego thornmint (*Acanthomintha ilicifolia*; Entity ID 496)), and two terrestrial invertebrates (e.g., the Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*; Entity ID 436) and the American burying beetle (*Nicrophorus americanus*; Entity ID 440).

In brief, the effect thresholds for the four organisms were modified in the "Toxicity inputs" worksheet located in the "WoE Input parameters" workbook for each neonic and subsequently loaded into the MAG TerrTool v2.3.1. The effect thresholds in the "Toxicity inputs" worksheets were multiplied by a factor of 1,000, 10,000, 100,000, 1,000,000 and 10,000,000 until the species investigated changed from an LAA to NLAA or NE determination.

To change the LAA species call to an NLAA or NE determination for these organisms the following changes were performed to the "Toxicity inputs" worksheet:

- The threshold effect values for terrestrial plants were multiplied by a factor of 100,000 for all three neonic chemicals. The threshold effect values for terrestrial invertebrates were multiplied by a factor of 100,000 for clothianidin and thiamethoxam and up to 10,000,000 for imidacloprid.
- Aside from the slopes, the duration of the study days and the weight of the animal every parameter in the toxicity input worksheet was multiplied by a factor of 100,000 for plants to address indirect effect (PPHD calculations). Similarly, every parameter, apart from the slopes, duration of the study and the weight of the animals, in the toxicity inputs worksheet for terrestrial invertebrates was multiplied by a factor of 100,000 for clothianidin and thiamethoxam and up to 10,000,000 for imidacloprid.

Although lower multipliers were used initially (i.e., 1,000x, and 10,000x), it became clear that significantly more orders of magnitude were required to begin to see a change from LAA to NLAA or NE for these organisms. Table A4 in Appendix A show increases in the multiplication factor before NLAA or NE determination were derived in the MAGtool output.

Table 6-2 shows the highest multiplication factor required to change the species call from LAA to NLAA or NE for the plants and terrestrial invertebrates species investigated. The highest multiplication factor applied to terrestrial plants to change to NE determination was 100,000x. However, since the LAA determination still occurred at 10,000x for both plant species is it likely that the multiplication factor required to change to NE determination occurs between 10,000x and 100,000x for all three neonic pesticides. Similarly, since the highest multiplication factor required to change the species call to NLAA or NE for terrestrial invertebrates is 100,000x for both clothianidin and thiamethoxam is it likely that the multiplication factor required to change from the LAA determination occurs when the toxicity parameters are multiplied between 10,000 and 100,000x. The highest multiplication factor applied to the toxicity inputs parameters in the imidacloprid BE for the effects determination to change to NE for the American burying beetle and Valley elderberry longhorn beetle were 1,000,000 and 10,000,000x, respectively. The multiplication factor required to change from the LAA determination likely occurs when the toxicity input parameters are multiplied between 100,000-1,000,000x and 1,000,000-10,000,000x for the American burying beetle and Valley elderberry longhorn beetle, respectively.

This case study is not a definitive quantitative analysis of the conservatism of the MAGtool. It is very clear from the previous carbamate BEs and the draft atrazine and glyphosate BEs that EPA's application of the Revised Method (EPA, 2020a) using the MAGtool results in an extremely conservative, and unrealistic assessment of risk. Compounding conservatism is clearly an issue with this tool, and as such it is extremely difficult once a May Affect determination is made, to arrive at anything but an LAA determination unless the species is deemed to be extinct or extirpated, found in the ocean where exposure is negligible and where effects through PPHD are not anticipated, the species is a karst organism or, on occasion, species with a common traits (e.g., beach habitat) may be considered unlikely to be exposed (Steps 2a-e)(see Table 2-2).

Table 6-2. The highest multiplication factor applied to benchmark parameters in the MAGtool toxicity inputs worksheet to change the species call from LAA to NLAA or NE for the three neonic pesticides

Neonic:	Clothianidin	Imidacloprid	Thiamethoxam
Plants:			
Thread-leaved brodiaea Entity ID 416	x100,000[a]	x100,000[a]	x100,000[a]
San Diego thornmint Entity ID 496	x100,000[a]	x100,000[a]	x100,000[a]
Terrestrial Invertebrates:			
Valley elderberry longhorn beetle Entity ID 436	x100,000[a]	x10,000,000[a]	x100,000[b]
American burying beetle Entity ID 440	x100,000[a]	x1,000,000[a]	x100,000[a]

[a] No Effect (NE) determination

[b] Not Likely to Adversely Affect (NLAA) determination

LAA – Likely to Adversely Affect

NLAA – Not Likely to Adversely Affect

x – Multiplication factor

Recommendation: MAGtool model conservatism should be quantitatively evaluated in a Science Advisory Panel (SAP) to ensure that the model is identifying listed species and or critical habitats where adverse effects are 'reasonably certain to occur' and identified using the best available data. Without this effort, the evaluation burden is being shifted to the Services as most listed species and critical habitats that enter the BE process will continue to require consultation whether they may be at potential risk, or not. Thus, the efficiency, transparency and the scientific robustness of the entire process will continue to be questioned.

6.1.3 General Transparency Issues

There are numerous general transparency issues with the MAGtool v2.3.1 that make evaluation difficult. Many of these are likely the result of the rushed timelines and limited resources available but are no less important to address for the sake of clarity on how to run the MAGtool and overall transparency as changes are made between versions. For example:

- In the Mag_TerrTool_v2.3.1.xlsm workbook found in the draft clothianidin, imidacloprid or thiamethoxan BEs, the 'Habitat' worksheet refers to TerrPlant and SWCC (Surface Water Concentration Calculator) as being the exposure model(s) used to evaluate exposure for terrestrial and wetland plant species. This appears to be no longer the case in the MAGtool v2.3.1.

- On pg. 10 of the MAGtool v2.3.1 Overview and user guide document, under the "MAG_TerrTool v2.3.1 (Animal analysis)" heading, the text needs to be updated to include clothianidin, imidacloprid or thiamethoxan instead of stating that the MAGtool is "currently only set to run for either carbaryl or methomyl". The same omission is noted on pg. 12 and 14 of the user guide under the "MAG_TerrTool v2.3.1 (Plant analysis)" and "MAG_AquaTool v2.3.1" headings.

- In the MAG_TerrTool_v2.3.1.xlsm workbook for clothianidin, imidacloprid or thiamethoxan, the 'README' worksheet describes how the "tool is currently only set to run for either carbaryl or methomyl." No mention is made of clothianidin, imidacloprid or thiamethoxan.

- Cell IC2 in the "Drift usage adjusted state plant" worksheet of the MAG TerrTool v2.3.1 workbook for clothianidin, imidacloprid and thiamethoxan MAGtools is labeled "PCT_Carbaryl AA". This label is confusing since it implies that the 3880 entries under this column contains data for carbaryl instead of the three neonic pesticides.

- EPA does not provide information on the version of Microsoft Excel required to run the MAGtool. This is very important information given that the public, registrants, and Services along with EPA users not directly associated with MAGtool development may not have Excel version 2019 or higher (e.g., Excel 365). Using the MAGtool in a previous version of Excel (e.g., 2016 or 2013) will result in errors in the tool. These errors are due to the use of new Excel functions used in the MAGtool such as MAXIFS[9] and MINIFS[10] which are not supported in the older versions of Excel rendering the MAGtool v2.2 useless in the older Excel versions.

- There were several instances where key folders and workbooks were missing from the draft neonic BEs and this made interpretation of the MAGtool difficult. For instance, in Appendix 4-9 of the draft thiamethoxam BE the MAGtool outputs for the GAP analysis were not provided (i.e., the "GAP" folder was missing) but the corresponding WoE outputs were provided. Moreover, in Appendix 4-9 of the draft imidacloprid BE the WoE outputs for the four aquatic species (i.e., Entity ID 211, 219, 488, and 1246) were presented as part of the "FishAqinvert_PROB" group and showed that probabilistic analysis was performed. However, the corresponding MAGtool outputs for this groups are not provided. These inconsistencies made interpretation of the MAGtool difficult.

Recommendation: These issues and others as documented in this report need to be addressed and resolved to provide confidence in application of the MAGtool for the neonicotinoids, particularly where other pesticide products are mentioned, and errors have been noted.

6.2 Quality Assurance and Quality Control

For a model as complex as the MAGtool, there should be a documented QA/QC process to ensure the model is functioning as intended (QA) and that the model inputs are accurate for each of the neonicotinoids (QC). To date, EPA has not provided a document on their QA/QC. The Agency does note in the BE reports that certain types of data follow a formal QC process (e.g., Attachment 1-5 for vegetative vigor and seedling emergence studies). Ideally this information would be found in the MAGtool v2.3.1 user guide provided with the tool (MAGtool 2.3.1 Overview and User Guide).

We noted while running the new version of the model (v2.3.1) that EPA has added some error checks that to our knowledge, did not previously exist. It appears that after MAGtool analyses are complete, two text documents are produced that document errors in the model (i.e., "MAGoutput error list.txt" and "ED Output file error list.txt"). These checks provide an indication that the MAGtool was run successfully and/or identifies errors in the runs. We ran the MAGtool to for the Alabama beach mouse (*Peromyscus polionotus ammobates*; Entity ID 41) as the example organism. Figure 6-4 shows the output from the MAG TerrTool v2.3.1 when the

[9] MAXIFS function - Office Support (microsoft.com)

[10] MINIFS function - Office Support (microsoft.com)

EPA default data are used (as downloaded) and with modification intentionally to produce errors (i.e., We used Entity ID “41.1” instead of 41 for the Alabama beach mouse).

Figure 6-4. Quality control check results with deliberate error in the MAGtool

Recommendation: The presence of internal tools to evaluate the correct application of the MAGtool is a welcome addition. However, the extent of and effectiveness of these QC checks and the existence of a QA process lacks transparency. Documenting these QA/QC processes in any of the user guides and/or the BEs documents is necessary to increase transparency and faith in the MAGtool, particularly due to the fact the MAGtool has never undergone a Science Advisory Panel review or similar review process.

There remain numerous quality control and assurance issues associated with the MAGtool v2.3.1. The Agency noted in the MAGtool 2.3.1 Overview and User Guide that they have continued to correct errors as identified in the public comments or model review. However, our review of the model still identifies some of the same errors previously reported as well as the additional errors noted throughout Section 6.0. Additional QA/QC errors are provided below, but do not represent the work of an exhaustive analysis given the complexity of the tool and the evaluation time limit imposed by the public comment period deadline.

- Toxicity threshold values that were used as inputs for the clothianidin MAGTool for monocots and dicots are inconsistent with the information presented in the Chapter 2 of the draft BE. In Chapter 2 of the draft clothianidin BE report, Table 2-6 shows that the values for direct effects (e.g., NOAEC, MATC (or LOAEC) and IC25) for monocots and dicots are ≥0.19 lb a.i./A. Additionally, Table 2-27 in Chapter 2 of the draft BE shows that the alternative toxicity endpoints for monocots and dicots are 1.9 lb a.i./A for MATC and IC25 endpoints. However, the "MAGTool inputs" worksheet in the MAG TerrTool v2.3.1 and the "Toxicity inputs worksheet" provided in the Appendix 4-2 workbook use the value of 99,999 lb a.i. /A for both direct and alternative toxicity endpoints. Since the MAGtool value is not discussed in the draft clothianidin BE it is unclear what this value represents although it is likely a placeholder value.

- The Excel code for the "Incident Reports" factor is not linked to the proper cell in the "Output by species" worksheet located in the "CB output template_Terr Plants_Effects determinations" workbook. The Excel formula from which the factor is calculated is found in cell C49 of the 'Outputs by Species' worksheet, and reads as follows:

  " =IF(C39="NLAA","NA",IF(OR(H35="Yes",G35="Yes"),"Increase","No impact on confidence"))"

  The cell H35 refers to the "Species Taxa" determination and cell G35 references a title: "Incidents Reports?". The H35 cell is coded in Excel to allow for changes in answer based on the MAGtool inputs, however, there is no Excel code available in cell G35 to allow for a "Yes" determination (see Figure 6-5). Furthermore, the MAGtool v2.3.1

Overview document indicates that the "Incident Reports" factor relies on information provided by the MAGtool for indirect and direct taxa. Because the cell I35 is based on information provided for indirect taxa and has Excel coding to allow for a "Yes" determination, it is reasonable to conclude that cell G35 in the original code should refer to cell I35. The same problem has also been observed in the "CB output template_Terr Animal_Effect determinations" and "CB output template_Aquatic_Effects determinations" workbooks in the clothianidin, imidacloprid and thiamethoxam MAGtools.

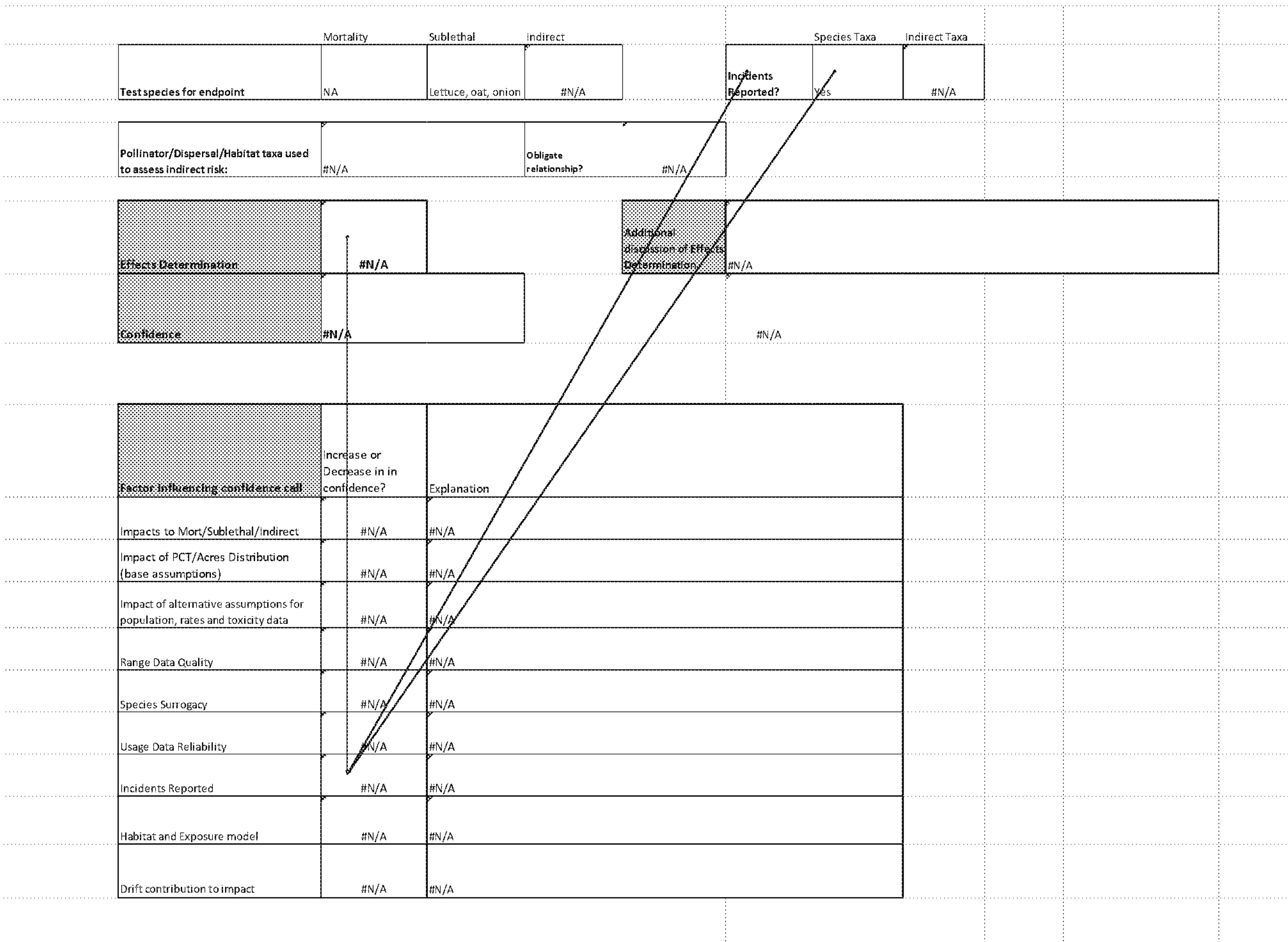
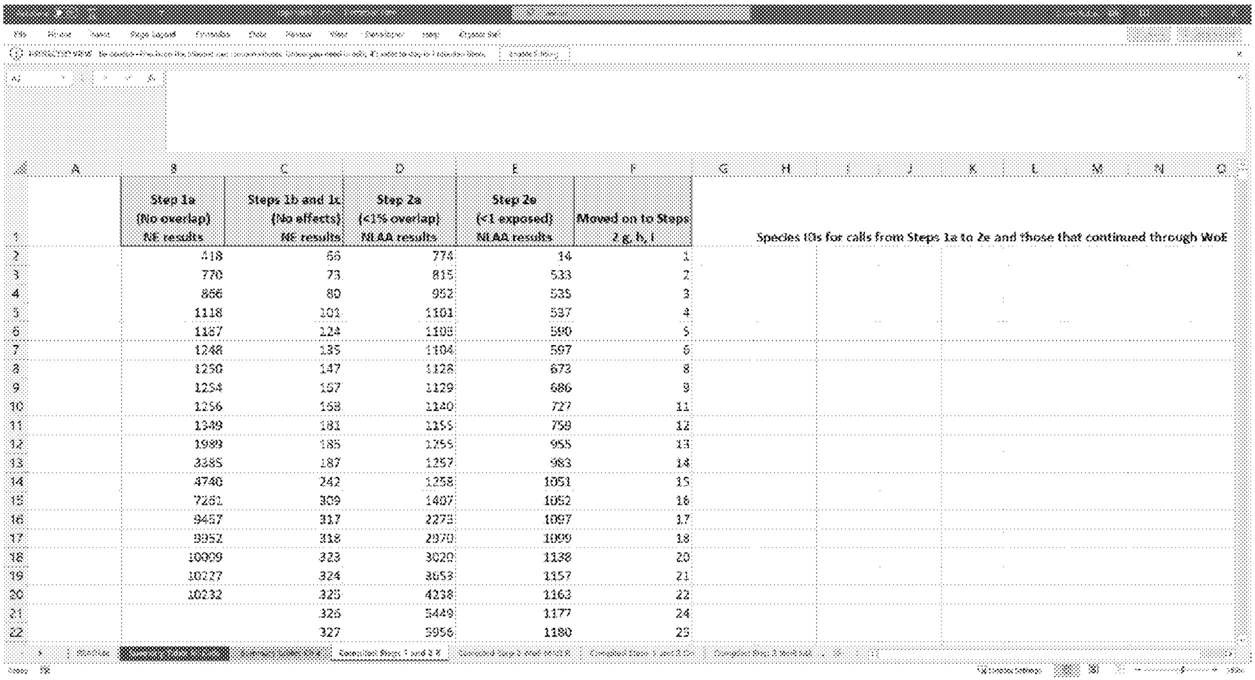


Figure 6-5. Excel Precedents (red arrow) and Dependents (blue arrows) for Cell C49 in the 'CB output template_Terr Plants_Effects determinations' workbook in the 'Output by Species' worksheet.

- The names of the steps in the MAGtool output files do not correspond with what was defined in the EPA Revised Guidance (EPA, 2020a). For instance, the guidance document defines Step 2a as "Is the exposure pathway incomplete?" but the same step in the MAGtool output is listed as "Step 2a (<1% overlap) - NLAA results" (see Appendix 4-1 workbook and throughout the MAGtool components). Step 2e in the Revised

Guidance (EPA, 2020a) is titled "Is the percent of species range/critical habitat that overlaps with the action area <1%?". In the MAGtool outputs, the Step 2e column describes a situation where <1 individual is exposed (e.g., "Step 2e (<1 exposed) - NLAA results"). The Figure 6-6 shows MAGtool outputs from Appendix 4-1 located in the draft BE for clothianidin, however, improper naming of steps was also noted in Appendix 4-1 of the imidacloprid and thiamethoxam MAGtools.



Step 1a (No overlap) NE results	Steps 1b and 1x (No effects) NE results	Step 2a (<1% overlap) NLAA results	Step 2e (<1 exposed) NLAA results	Moved on to Steps 2 g, h, i
418	66	774	14	1
770	73	815	533	2
866	80	952	535	3
1118	101	1101	537	4
1187	124	1103	590	5
1248	135	1104	597	6
1250	147	1128	673	8
1254	157	1129	686	9
1256	158	1140	727	11
1349	181	1155	759	12
1989	185	1255	955	13
3385	187	1257	983	14
4740	242	1258	1051	15
7261	309	1407	1052	16
9457	317	2273	1097	17
9952	318	2970	1099	18
10009	323	3020	1138	20
10227	324	3653	1157	21
10232	325	4238	1163	22
	326	5449	1177	24
	327	5956	1180	25

Species IDs for calls from Steps 1a to 2e and those that continued through WoE

Figure 6-6. Excel output from Appendix 4-1 showing descriptive titles for Step2a and Step 2e in Appendix 4-1 of the draft clothianidin BE.

Recommendation: The Agency needs to spend time to finally update their user guides and readme files to capture all the submitted comments on these materials on the nine BEs (i.e., carbamates, herbicides, neonicotinoids) to increase transparency, provide updated instruction, and further document changes to the newest version of the MAGtool being applied.

6.3 Incorporation of Usage Data and PCT

6.3.1 Overview

The UDLs and calculations of percent crop treated (PCT) provide direct inputs to the MAGtool in determining LAA versus NLAA decisions and quantifying the level of confidence in the Weight of Evidence (WoE) analysis. The PCT calculations and determinations of treated areas based on UDLs has been discussed extensively in the Section 3.0. Two different usage scenarios are considered in the neonicotinoid applications of the MAGtool in the WoE analysis. These are as follows:

1. Maximum/Upper: This usage scenario incorporates the maximum annual PCT based on 5 years of data (for each UDL) and assumes that all usage first occurs within a species range and then occurs outside the species range once all potential use sites within the species range have been treated. This represents a "worst case" scenario, with the lowest likelihood of occurring.
2. Average/Uniform: This usage scenario incorporates the average annual PCT based on 5 years of data (for each UDL) and assumes that all usage is evenly distributed within and outside of a species range. This represents the most likely scenario to occur based on the interpretation of the usage data. However, as discussed in the previous sections, there were multiple flaws in the calculations of PCTs from the usage data.

The "worst case" scenario is first used in Step 2f where the proportion of the species range or critical habitat that overlaps with the exposure area (treated area plus off-site drift transport) is calculated and multiplied by the population size to calculate the number of individuals exposed. If less than one individual is exposed, a NLAA determination is made. If one or more individuals are potentially exposed, then the species evaluation moves to Step 2g.

Both likelihood and impact of exposure are considered in steps 2g/h/i as part of WoE effects determination for species that are not screened out at step 2g. Determining the impact of exposure is supposed to involve a probabilistic analysis where several variables that influence exposure are sampled and thousands of individuals of a species are simulated to represent a range of potential exposure magnitudes (note, this probabilistic exposure analysis was not conducted for aquatic species in the neonicotinoid BEs, which is discussed later). This calculation implicitly assumes that individuals of a species as well as neonicotinoid usage across a UDL (quantified through the assumed PCT) are evenly distributed across a species range.

The worst case ("maximum/upper") usage scenario is used in Step 2g in making the LAA/NLAA decision. The PCT-adjusted overlap percentage between the action area and the species range is used to determine the number of individuals potentially exposed. If this analysis results in at least one individual being affected, then the species will always be assigned an LAA determination and the level of confidence in the LAA determination is then quantified using species impact assessments from Steps 2h and 2i (as well as 7 additional qualitative criteria in the WoE analysis).

Species impact is evaluated under the more likely "average/uniform" usage scenario in Step 2h, while Step 2i assesses impact under the "worst case" usage scenario and alternative assumptions for species sensitivity and life history (e.g., population size, toxicity surrogacy, habitat, migration). In the WoE analysis, these two usage scenarios are coupled with different combinations of effects endpoints (e.g., indirect and/or direct effects, and alternative assumptions regarding toxicity and population) to either increase or decrease the confidence in the LAA determination. The possibility of direct or indirect effects to one individual based on the "average/uniform" usage scenario may increase confidence in LAA if exposure to greater than one individual is predicted or decrease confidence in LAA if exposure to greater than one individual is not predicted. However, the influence of the "average/uniform" usage scenario in Step 2h on WoE confidence is linked to other criteria, limiting its overall impact on confidence outcomes. Only one of the 10 WoE analysis criteria include the consideration of this more likely usage scenario.

The two usage scenarios that have been described in these comments serve as some of the most critical inputs to the MAGtool. Section 3.0 of this document provided extensive review and critique of how PCTs and treated areas for each neonicotinoid UDLs were derived. The critique in this section will focus on how these PCTs were applied in the MAGtool and how the analysis impacted effects determinations.

6.3.2 Critique of Methodology and Recommendations

The incorporation of the usage data into the MAGtool analysis had minimal impact on the outcome of species NLAA/LAA determinations and in refining the confidence in the resulting LAA determinations. This is observed in each of the BEs (Chapter 4, Table 4-3 (EPA, 2021a; EPA, 2021b; EPA, 2021c)), based on the low numbers of species receiving NLAA calls at Step 2f and Step 2g/h/i (although the less conservative usage data does not appear to be responsible for those NLAA calls and Step 2g/h/i). The vast majority of the LAA determinations for each neonicotinoid were classified as moderate evidence (Chapter 4, Table 4-4 (EPA, 2021a; EPA, 2021b; EPA, 2021c)), with 78% for clothianidin, 97% for imidacloprid, and 86% for thiamethoxam.

While bringing usage data into the BE is a strong step in the right direction, the assumptions under which usage data have been analyzed and subsequently incorporated into the MAGtool has led to minimal refinement (realism) in the overall risk assessment compared to having ignored usage data and assumed 100% PCT for all neonicotinoid potential use sites. The limited impact to species effects determinations resulting from incorporating usage data into the neonicotinoid BE is the result of a series of assumptions and miscalculations resulting in compounding levels of conservatism, many of which were discussed in Section 3.0. Here, we identify several additional factors that contributed to this outcome:

1. ***Determination for NLAA Versus LAA Is Based Nearly Entirely upon the "Worst Case" Usage Scenario:*** The worst case ("maximum/upper") usage scenario is not only a highly unlikely scenario, but it can also in some cases represent an almost impossible scenario with near zero likelihood of occurring in the environment. For species, whose range or critical habitat is substantially smaller than the area of an entire state (the spatial unit for usage allocation), the assumptions associated with this worst-case scenario become increasingly unrealistic and approach impossible. The approach implemented in the MAGtool to effectively only allow an NLAA determination based upon a highly

improbable set of assumptions does not appropriately consider "best available" data and does not support the concept of "likely to adversely affect" at this critical step in the BE.

Recommendation: A usage scenario designed to represent a highly unlikely conservative worst-case situation should not be used in NLAA/LAA decisions as was the case in the neonicotinoid BE implementation of the MAGtool. Adopting a more reasonable interpretation of a conservative usage scenario coupled with including more likely and more highly probable usage scenarios in an NLAA determination will help to remedy the current approach implemented in the MAGtool.

2. ***The More Likely Usage Scenario ("Average/Uniform") Only Comes into Play in One of the 10 Criteria Evaluated in the WoE Analysis.*** First, this means that the most likely usage scenario (based on best available data) can only impact the confidence in an LAA determination which itself was made based on a highly improbable set of usage assumptions. Second, the "average/uniform" usage scenario, which is the most likely scenario, cannot on its own change the confidence level in the LAA determination. This is because there are nine additional factors that influence the adjustment of LAA confidence level in the WoE analysis (Attachment 4-1, Table 1 of EPA, 2021a; EPA, 2021b; EPA, 2021c). Therefore, these critical data, the best available interpretation of neonicotinoid usage within a species range or critical habitat, has a nearly inconsequential impact on the results of the risk assessment and the resulting work to be conducted by the Services in preparing a Biological Opinion.

   Recommendation: The consideration of the "average/uniform" usage scenario should be given more weight in the quantitative components of the Step 2 analyses through the MAGtool. This would include direct consideration in the NLAA/LAA decision at Step 2f, and stronger influence in the weight of evidence analysis in Steps 2g/h/i. As is the situation for the "maximum/upper" usage scenario, the value of these usage scenarios within the MAGtool will be greatly improved as more accurate and realistic PCTs and treated acres are derived to reflect the worst case and expected usage situations.

3. ***Ag PCTs and Non-Ag PCTs: The "Maximum/Upper" Usage Scenario Is Unreasonably Conservative When Allocating All State Treated Acres to Occur within Every Species Range/Critical Habitat:*** The maximum/upper usage scenario is the most conservative usage scenario, using the maximum PCT treated acres and assuming all usage in a state occurs within a species range. When the geographic regions representing species ranges/critical habitat are independent (i.e., no overlap), the outcome when looking across multiple species is that treated areas can vastly exceed the intended state-level PCT and associated treated areas for each UDL. This is because the treated acres for an entire state keep getting focused over different geographic locations associated with multiple species ranges. Given the importance that the "maximum/upper" scenario has in Step 2 of the effect determinations, the impacts of this unrealistic conservatism may be

substantial.

Recommendation: The assumption of all state-level usage occurring within a species range combined with the maximum PCT as a most conservative usage scenario should be revised. The potential impacts of the same maximum treated acres for a UDL within a state getting moved around the state to always fall within different species ranges is unreasonably unrealistic, especially given the weight applied to the most conservative usage scenario throughout Step 2 of the neonicotinoid BEs. An appropriately conservative alterative would be to use a "maximum/uniform" scenario in place of the "maximum/upper" scenarios to represent the higher end usage scenario for the effects determinations. The "upper" scenario of assuming all usage in state occurs within every species range has no defensibility with any available data.

4. ***The PCT and Associated Treated Area Analysis Was Flawed, Leading to Unrealistic MAGtool Results for CONUS Species:*** The flaws in the analysis of PCT and treated areas were discussed in Section 3.0, with multiple examples provided as support. Outcomes from the MAGtool analysis provide further evidence of the need for significant revisions to the usage and subsequent PCT/treated areas analysis.

   Table 4-8 of Chapter 4 lists the number of times a UDL was predicted to impact a species based on draft LAA determinations. This summary, for each of the three neonicotinoids, is replicated below in Table 6-3. Across all neonicotinoids, the UDLs impacting the highest number of species are all non-agricultural, with Open Space Developed, Developed, Managed Forest, and Poultry Litter uniformly the top UDLs. The Other Crops UDL (which includes fallow and sod) and the Field Nurseries UDLs follow. The first legitimate agricultural UDLs that rank high are Vegetables and Ground Fruit and Other Orchards. These top ranking agricultural UDLs have on the order of 50% of the number of species impacted compared to the highest ranking non-agricultural UDLs. A general assessment of the Usage Data Quality, based on information provided in the SUUMs (Appendix 1-4) and subsequent discussions has been provided in the Table 6-3 as well.

   The troubling trend seen in Table 6-3 is that the UDLs impacting the highest number of species have little to no reliable usage data associated with them. Apart from Poultry Litter for thiamethoxam, 100% PCT was assumed for all of the non-agricultural UDLs. Further, some agricultural UDLs, such as the Other Crops effectively had no usage data available, so PCTs of nearly 100% were assumed based on the surrogate usage data approach. Even in some cases where usage data was available for much of the UDL (e.g., Other Orchards), usage data surrogacy rules resulted in PCTs that were incongruent with the best available data. This relative ranking of UDL impacts to species demonstrates a disconnection between best available information on usage of neonicotinoids, coupled with common understanding of the chemical uses, and conclusions drawn from the MAGtool analysis; even when acknowledging the variability in locations of potential use sites relative to species ranges. Is it sensible that the Open Space Developed UDL, accounting for parks and golf courses, is having more than double the impact to listed species as every agricultural potential use site?

Table 6-3. Number of Impacted CONUS Species by UDL				
UDL	**Number of Species Impacted**			***Usage Data Quality***
	Clothianidin	***Imidacloprid***	***Thiamethoxam***	
CONUS_Open Space Developed	830	833	803	None/Low
CONUS_Developed	749	752	735	None/Low
CONUS_Managed Forests		726		None
CONUS_Poultry Litter	516	524	512	None
CONUS_Other Crops	419	432	404	None
CONUS_Field Nurseries		429	563	None
CONUS_Vegetables and ground fruit	295	325	417	Medium
CONUS_Other Orchards	256	296	391	Medium
CONUS_Other Row Crops	43	176	103	Medium
CONUS_Cotton	166	175	195	High
CONUS_Grapes	143	167	218	High
CONUS_Soybeans	153	162	171	High
CONUS_Citrus	46	113	151	High
CONUS_Xmas Trees		80	72	None

Recommendation: This evaluation points to the ramifications of the significant flaws in the assumptions and methods used to derive PCTs, treated areas, and ultimately overlap areas between treated use sites and species ranges in the MAGtool-based effects determinations. The conclusion that multiple neonicotinoid uses, where usage is so low that it has not received attention for quantification, have the greatest impacts to listed species across the CONUS brings doubt to the outcomes of many effects determinations. The consideration of usage data and PCTs in the MAGtool and other neonicotinoid BE components needs to be redone using more defensible assumptions and analysis methods. At a minimum, when highly questionable and uncertain usage assumptions are driving impacts and outcomes for species, an LAA call needs to have very low confidence indicated.

5. ***The PCT and Associated Treated Area Analysis Was Flawed, Leading to Unrealistic MAGtool Results for NL48 Species:*** Like the analysis of CONUS species ranges and critical habitats, the NL48 species results presented in Table 4-8 of Chapter 4 (EPA, 2021a; EPA, 2021b; EPA 2021c), suggest many more species being impacted by the non-agricultural noenicitinoid uses than by the agricultural uses. These results, summarized from the three BEs, are provided in Table 6-4. These conclusions are driven by the assumptions of 100% PCT for non-agicultural UDLs and have no foundation in reality to support the results.

Table 6-4. Number of Impacted NL48 Species by UDL

UDL	Number of Species Impacted			*Usage Data Quality*
	Clothianidin	*Imidacloprid*	*Thiamethoxam*	
CONUS_Managed Forests		526	509	None
CONUS_Developed	352	356	355	None
CONUS_Open Space Developed	277	283	230	None
CONUS_Poultry Litter	104	110	105	None
CONUS_Ag	102	106	101	Low
CONUS_Field Nurseries		18	40	None

Recommendation: Revisions to the process for estimating PCTs for the NL48 regions is required, particularly for uses lacking survey data. The revised process should include better-informed judgements that lead to plausible usage scenarios. Effort in this area should help in the more accurate identification of neonicotinoid uses having the greatest impacts on listed species.

6. ***The PCT and Overlay Analysis in the MAGtool Cannot be Fully Reviewed Without Access to the Spatial Data Files:*** Each of the neonicotinoid BEs includes a MAGtool input file with critical inputs and outputs from a GIS spatial analysis. This spreadsheet file was provided with the package of MAGtool inputs and outputs associated with each neonicotinoid (e.g., "GIS Input file_Range_Clothianidin.xlsx", "GIS Input file_Range_Imidacloprid.xlsx", "GIS Input file_Range_Thiamethoxam.xlsx"). While these input files are helpful in understanding the many spatial quantities that served as MAGtool inputs, they do not provide enough detail needed to understand how those spatial quantities were derived. For this, the spatial datasets themselves are needed.

Recommendation: The critical GIS spatial layers, species ranges, UDLs, and output layers used in quantifying the various overlay analyses should be provided to increase understanding, reproducibility, and transparency of the analysis for stakeholders.

6.4 MAGtool Aquatic Exposure Estimates

6.4.1 Overview

The MAGtool was applied at Step 2 to make effects determinations for between 1,562 and 1,612 aquatic species ranges and between 660 and 713 aquatic species critical habitats across the three neonicotinoid BEs. Aquatic exposure values by habitat bin and UDL were provided at the HUC2 watershed level as inputs to the MAGtool. For deterministic MAGtool assessments, the 1-in-15-year annual maximum EECs from the PWC simulations run for each UDL and HUC are considered. Maximum and minimum 1-in-15 year annual maximums are compiled at the HUC2 level by UDL (sometimes there are multiple PWC scenarios for the same HUC2/UDL). When a species is then assessed deterministically, all HUC2/UDL EECs for a given species are considered collectively, with the overall maximum and overall minimum assessed against effects endpoints. The practical implication of this approach is that only two EECs are evaluated for each species, the overall maximum 1-in-15-year EEC and the overall "minimum" 1-in-15 year EEC (note that the "minimum" 1-in-15 year EEC is still highly conservative and this will be discussed later in this section).

The probabilistic MAGtool modeling approach was intended to take a distributional approach to aquatic exposure. As described in the Revised Methods document (EPA, 2020a), multiple annual maximum EECs are included (not just the 1-in-15-year values) and variability in exposure resulting from application timing and runoff variability are accounted for through EEC adjustment factors. For static water habitat (Bin 6 and Bin 7), each of the 30 annual maximum EECs from each PWC simulation are included in the exposure distributions for each species. In the case of flowing water habitat (Bin 3 and Bin 4), 90 daily concentrations around each year's annual maximum are considered in the probabilistic exposure distributions. When exposure values impacting a given species are extracted from these EEC distributions, adjustment factors to account for application timing and runoff variability are also randomly drawn and applied to the EEC. Although this probabilistic approach to assigning exposure to species misses several important aspects to estimating exposure (most notably, not accounting for PCA and PCT), the general principle is a sound approach.

6.4.2 Critique and Recommendations

Review of the MAGtool aquatic exposure inputs and outputs generated for the neonicotinoid BEs, as well as how the MAGtool was applied from an aquatic exposure standpoint, identified several findings that have brought about concern over the application of the tool for the neonicotinoids. These findings are discussed below.

1. ***The MAGtool was Only Run Using the Deterministic Mode for Nearly All Aquatic Species:*** The MAGtool appears to have been primarily run in deterministic mode for

nearly all species, which overly simplified the exposure potential for many species. The MAGtool's consideration of probabilistic exposure distributions has been noted as a strength to the tool, however, in the case of the neonicotinoids, this strength of the MAGtool was not realized.

Recommendation: The MAGtool should be run in full probabilistic mode to better understand the exposure potential for each species.

2. ***Applying the MAGtool Only in Deterministic Mode Limited the Range in Aquatic Exposure Values to Between the Deterministic "Minimum" and "Maximum", Ignoring Other Representative EECs for the Species:*** For each species, the deterministic EECs for each UDL were extracted from the PWC 1-in-15 year 1-day EECs from each simulation associated with the UDL. For cases where there were multiple HUC2s associated with a species range/critical habitat and/or multiple PWC scenarios per UDL, the maximum and minimum 1-in-15 year 1-day EECs from all relevant simulations were assigned to the species. If there were effects to the species based on the "minimum" EEC, then it was assumed that a "probabilistic" analysis was not required. This assumption incorrectly associated the "minimum" 1-in-15 year EEC represented a low-end exposure value for the species. However, the probabilistic analysis in the MAGtool considers ALL 30 annual maximum EECs (not just the 1-in-15 year), and furthermore, the application date and runoff CN adjustment factors typically lower the annual maximum EECs from the baseline PWC model results. Furthermore, for Bin 3/Bin 4 species, 90 daily exposure values from each year of each simulation are considered, leadings to a high likelihood of substantially lower 1-day EECs as compared to the deterministic values.

   Recommendation: The justification for only running the MAGtool deterministically was flawed. Considerably lower, and relevant, EECs for all aquatic species would have been considered if the tool was run in probabilistic mode, potentially changing effects outcomes.

3. ***The MAGtool Application Date Adjustment Factors for Aquatic EECs do Not Appear to Account for Valid Application Timing Variability by UDL, Use Pattern, and Scenario:*** Chapter 4, Appendix 4-4 in the BEs provides the application date scaling factors for each Bin, UDL, and HUC2. These scaling factors were generated for Julian Day 1 through 365 and are provided as one of the MAGtool input spreadsheets (see Appendix 4-2). While it appears that the MAGtool was not run using the probabilistic mode to assess species in the neonicotinoid BEs, it also appears that there is no mechanism within the input file structure of the MAGtool to constrain the application date adjustment factors to align with valid application dates for a given use pattern. This is despite the indication in Chapter 3 Section 3.4.3 (EPA, 2021a) that only relevant application dates are considered for each scenario. For example, application dates for

foliar uses of neonicotinoids outside the period between emergence and the Pre-Harvest Interval (PHI) are invalid, thus application date adjustment factors associated with those dates should not be considered in the probabilistic assessment. While it is possible that a MAGtool input that constrains the possible application date adjustment factors to appropriate Julian dates was missed during our review, the constraint to valid application dates is critical to obtaining realistic refinements in exposure due to application timing variability

Recommendation: The constraint of application date adjustment factors in the MAGtool to valid application dates is critical. A mechanism to provide these constraints on a UDL and HUC2 basis should be readily available and transparent for any MAGtool users to implement. Based on our review, we could not identify any mechanism by which these application date constraints can be provided.

4. ***The Methodology Used to Generate Application Date Adjustment Factors for Aquatic EECs for Each Julian Date is Seriously Flawed:*** Chapter 4 Appendix 4-4 of the BEs provides the application date scaling factors for each UDL and HUC2. The "ReadMe" tab of that spreadsheet describes the methodology for generating the scaling factors for each Julian Date. Instead of generating adjustment factors specific to each neonicotinoid, based on each's environmental fate properties and for the application dates specifically associated with their use patterns, the application scaling factors were based on previous BEs (carbaryl, methomyl, atrazine, simazine, and propazine, and glyphosate).

   The first flaw in this approach is that the sensitivity of runoff exposure to application timing will vary based on a pesticide's environmental fate properties and use patterns. Basing each neonicotinoid's application timing adjustment factors on other active ingredients, is overly generalized and scientifically inappropriate. The second, and very significant flaw, is that for each UDL/HUC2/Bin combination, scaling factors were randomly generated for each Julian Date based on a normal distribution fit to the scaling factors from the previous BEs. This approach completely ignored the seasonality of application timing scaling factors because the scaling factors for each Julian Date were all randomly drawn from the same normal distribution. This is demonstrated in Figure 6-7 below which shows the application date adjustment factors for 1 of the 5 realizations in the BE inputs for cotton in California (HUC2-18) for Bin 4. In California's Central Valley, there is almost no rainfall between May 1st and September 30th. Therefore, application date adjustment factors during this very dry time, with no runoff, should be consistently well below 1.0, with much higher adjustment factors associated with the rainy season, from October through April. The graph of adjustment factors shows a completely random pattern, not accounting at all for the actual impacts of climate seasonality on exposure variability. These application date adjustment factors are clearly invalid for application timing in California. As the same randomization of Julian Date adjustment factors was followed for all UDLs and HUC2s, all the application date adjustment factors generated for the neonicotinoid BEs have similar errors.

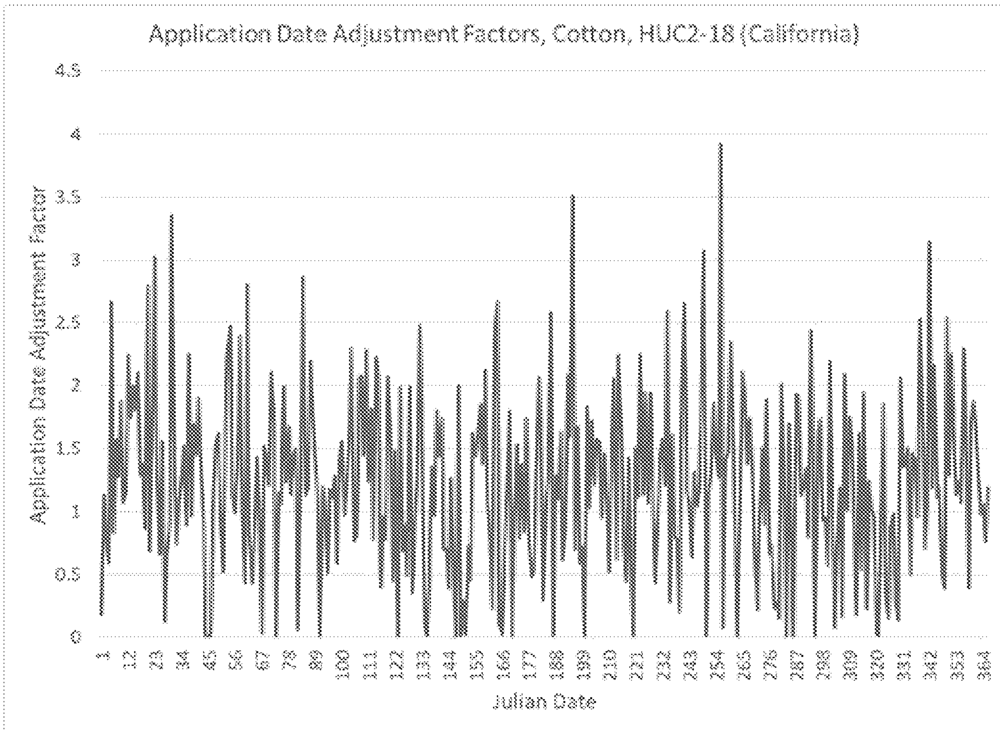


Figure 6-7. Application Timing Adjustment Factors for Neonicotinoids by Julian Date

Recommendation: The approach implemented in the neonicotinoid BEs to randomly generate application date adjustment factors based on previous BEs was invalid and should be corrected. To properly implement the concept of application date adjustment factors in the MAGtool, the adjustment factors must be generated specific to the chemical being assessed. They also must be Julian Date specific, thus actually reflect the change in exposure from a "baseline" application timing associated with each specific date assessed.

5. ***The Use of Application Timing Adjustment Factors in the MAGtool to Account for Application Timing Variability is Unnecessarily Complicated:*** To account for variability in aquatic exposure due to application timing, the MAGtool implements an adjustment factor approach, where adjustment factors associated with different alternative application dates are randomly chosen to adjust "baseline" exposure values generated from a scenario simulation using one application timing realization. A very straightforward alternative to the adjustment factor approach is to simply run simulations for each UDL/HUC2 scenario across all application dates within a valid application

window associated with each scenario. This would result in a larger population of EECs to draw from (both in the case of Bin6/7, where 30 annual maximums per simulation are considered and for Bin3/4 were 90 daily concentrations per year are considered) but would have the advantage of already accounting for application timing variability and be very specific to the active ingredient, use pattern, and scenario being simulated.

Recommendation: Aquatic exposure is very sensitive to application timing for many active ingredients, use patterns, and scenarios. Rather than account for this by using more generalized adjustment factors, each UDL/HUC2/Bin use pattern simulation should be run for all valid and realistic application dates, then pool these EECs into a distribution drawn from by the MAGtool.

6. ***The Curve Number (Runoff) Adjustment Factors in the MAGtool were Not Based on Neonicotinoid Simulations:*** Like the application timing adjustment factors discussed in the previous points, the Curve Number (CN) adjustment factors were also based on factors developed from previous BEs prepared for different active ingredients (carbaryl, methomyl, atrazine, simazine, and propazine, and glyphosate). Given that the determination of the CN adjustment factors is a very straightforward process, it is unclear why chemical specific factors were not generated for each of the neonicotinoids, just as had been done in the previous six BEs. As is true for the impacts of application timing on exposure variability, the impacts on CN variability on exposure are also dependent upon environmental fate properties of the active ingredient, thus chemical specific adjustment factors are important.

   Recommendation: For probabilistic applications of the MAGtool, chemical specific CN adjustment factor should be developed for each of the neonicotinoids.

7.0 CONCLUSIONS

Our review focussed on many of the modeling aspects of the draft BEs for clothianidin, imidacloprid, and thiamethoxam. The draft neonicotinoid BEs require considerable work to address the errors identified, and we have strived to provide recommendations to assist the Agency in the process.

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APPENDIX A – Comparison of Results for MAGtool v2.3.1 Runs by the EPA and Intrinsik.

Table A1. Duplication of results from the native clothianidin MAGtool

Taxon	*Scientific Name*	*BE Test Group*	*Common Name*	*Entity ID*	*Analysis Type Probabilistic or Deterministic*	*US EPA Results*			*Intrinsik Corp Results*		
						Source of Species Effects Determination	*Species Call*	*Strength of Call*	*Source of Species Effects Determination*	*Species Call*	*Strength of Call*
Plants	*Acanthomintha ilicifolia*	Group 1	San Diego thornmint	496	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Alopecurus aequalis var. sonomensis*	Group 1	Sonoma alopecurus	498	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Ambrosia pumila*	Group 1	San Diego ambrosia	500	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Arabis hoffmannii*	Group 1	Hoffmann's rock-cress	501	Deterministic	Terr WoE	NLAA	NA	Terr WoE	NLAA	NA
Plants	*Arctostaphylos glandulosa ssp. crassifolia*	Group 1	Del Mar manzanita	502	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Arctostaphylos confertiflora*	Group 1	Santa Rosa Island manzanita	503	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Arctostaphylos myrtifolia*	Group 1	Ione manzanita	504	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Arctostaphylos pallida*	Group 1	Pallid manzanita	505	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Arenaria ursina*	Group 1	Bear Valley sandwort	506	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA

Table A1. Duplication of results from the native clothianidin MAGtool											
Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type Probabilistic or Deterministic***	***US EPA Results***			***Intrinsik Corp Results***		
						Source of Species Effects Determination	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Plants	*Astragalus brauntonii*	Group 1	Braunton's milk-vetch	507	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Astragalus clarianus*	Group 1	Clara Hunt's milk-vetch	508	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Astragalus jaegerianus*	Group 1	Lane Mountain milk-vetch	510	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Astragalus pycnostachyus var. lanosissimus*	Group 1	Ventura Marsh Milk-vetch	511	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Astragalus tener var. titi*	Group 1	Coastal dunes milk-vetch	512	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Astrophytum asterias*	Group 1	Star cactus	513	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Berberis nevinii*	Group 1	Nevin's barberry	514	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Berberis pinnata ssp. insularis*	Group 1	Island Barberry	515	Deterministic	Terr WoE	NLAA	NA	Terr WoE	NLAA	NA
Plants	*Brodiaea filifolia*	Group 1	Thread-leaved brodiaea	516	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Brodiaea pallida*	Group 1	Chinese Camp brodiaea	517	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA

Table A1. Duplication of results from the native clothianidin MAGtool

Taxon	Scientific Name	BE Test Group	Common Name	Entity ID	Analysis Type Probabilistic or Deterministic	US EPA Results			Intrinsik Corp Results		
						Source of Species Effects Determination	Species Call	Strength of Call	Source of Species Effects Determination	Species Call	Strength of Call
Plants	*Calyptridium pulchellum*	Group 1	Mariposa pussypaws	519	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Calystegia stebbinsii*	Group 1	Stebbins' morning-glory	520	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Carex albida*	Group 1	White sedge	521	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Castilleja campestris ssp. succulenta*	Group 1	Fleshy owl's-clover	522	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Plants	*Castilleja cinerea*	Group 1	Ash-grey paintbrush	523	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Castilleja mollis*	Group 1	Soft-leaved paintbrush	524	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Ceanothus roderickii*	Group1	Pine Hill ceanothus	525	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Cercocarpus traskiae*	Group1	Catalina Island mountain-mahogany	526	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Chamaesyce hooveri*	Group1	Hoovers spurge	527	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA

Table A1. Duplication of results from the native clothianidin MAGtool											
Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type Probabilistic or Deterministic***	***US EPA Results***			***Intrinsik Corp Results***		
						Source of Species Effects Determination	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Plants	*Chlorogalum purpureum*	Group1	purple amole	528	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Chorizanthe orcuttiana*	Group1	Orcutts spineflower	529	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Cirsium hydrophilum var. hydrophilum*	Group1	Suisun thistle	530	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Cirsium loncholepis*	Group1	La Graciosa thistle	531	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Plants	*Clarkia imbricata*	Group1	Vine Hill clarkia	532	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Cordylanthus mollis ssp. mollis*	Group1	Soft birds-beak	534	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Delphinium bakeri*	Group1	Bakers larkspur	539	Deterministic	Terr WoE	NLAA	NA	Terr WoE	NLAA	NA
Plants	*Delphinium luteum*	Group1	Yellow larkspur	540	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Dudleya abramsii ssp. parva*	Group1	Conejo dudleya	541	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Dudleya cymosa ssp. marcescens*	Group1	Marcescent dudleya	542	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA

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Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type Probabilistic or Deterministic***	***US EPA Results***			***Intrinsik Corp Results***		
						Source of Species Effects Determination	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Plants	*Dudleya nesiotica*	Group1	Santa Cruz Island dudleya	543	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Dudleya stolonifera*	Group1	Laguna Beach liveforever	544	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Eriodictyon capitatum*	Group1	Lompoc yerba santa	546	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Eriogonum apricum (incl. var. prostratum)*	Group1	Ione (incl. Irish Hill) buckwheat	547	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Plants	*Eriogonum kennedyi var. austromontanum*	Group1	Southern mountain wild-buckwheat	548	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Fremontodendron californicum ssp. decumbens*	Group1	Pine Hill flannelbush	550	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Fritillaria gentneri*	Group1	Gentners Fritillary	551	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Plants	*Galium buxifolium*	Group1	Island bedstraw	552	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Galium californicum ssp. sierrae*	Group1	El Dorado bedstraw	553	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA

Table A1. Duplication of results from the native clothianidin MAGtool

Taxon	*Scientific Name*	*BE Test Group*	*Common Name*	*Entity ID*	*Analysis Type Probabilistic or Deterministic*	*US EPA Results*			*Intrinsik Corp Results*		
						Source of Species Effects Determination	*Species Call*	*Strength of Call*	*Source of Species Effects Determination*	*Species Call*	*Strength of Call*
Plants	*Gilia tenuiflora ssp. hoffmannii*	Group1	Hoffmanns slender-flowered gilia	555	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Hackelia venusta*	Group1	Showy stickseed	556	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Helianthemum greenei*	Group1	Island rush-rose	557	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Helianthus paradoxus*	Group1	Pecos (puzzle paradox) sunflower	558	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Deinandra (=Hemizonia) conjugens*	Group1	Otay tarplant	559	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Holocarpha macradenia*	Group1	Santa Cruz tarplant	562	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Lasthenia conjugens*	Group1	Contra Costa goldfields	566	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Plants	*Lesquerella perforata*	Group1	Spring Creek bladderpod	568	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Lesquerella thamnophila*	Group1	Zapata bladderpod	569	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Plants	*Lilium pardalinum ssp. pitkinense*	Group1	Pitkin Marsh lily	570	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA

Table A1. Duplication of results from the native clothianidin MAGtool											
Taxon	*Scientific Name*	*BE Test Group*	*Common Name*	*Entity ID*	*Analysis Type Probabilistic or Deterministic*	*US EPA Results*			*Intrinsik Corp Results*		
						Source of Species Effects Determination	*Species Call*	*Strength of Call*	*Source of Species Effects Determination*	*Species Call*	*Strength of Call*
Plants	*Lithophragma maximum*	Group1	San Clemente Island woodland-star	571	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Lupinus nipomensis*	Group1	Nipomo Mesa lupine	573	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Malacothamnus fasciculatus var. nesioticus*	Group1	Santa Cruz Island bush-mallow	574	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Monardella viminea*	Group1	Willowy monardella	576	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Navarretia leucocephala ssp. pauciflora (=N. pauciflora)*	Group1	Few-flowered navarretia	578	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Navarretia leucocephala ssp. plieantha*	Group1	Many-flowered navarretia	579	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Neostapfia colusana*	Group1	Colusa grass	580	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Orcuttia pilosa*	Group1	Hairy Orcutt grass	582	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Plants	*Orcuttia tenuis*	Group1	Slender Orcutt grass	583	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA

Table A1. Duplication of results from the native clothianidin MAGtool

Taxon	*Scientific Name*	*BE Test Group*	*Common Name*	*Entity ID*	*Analysis Type Probabilistic or Deterministic*	*US EPA Results*			*Intrinsik Corp Results*		
						Source of Species Effects Determination	*Species Call*	*Strength of Call*	*Source of Species Effects Determination*	*Species Call*	*Strength of Call*
Plants	*Parvisedum leiocarpum*	Group1	Lake County stonecrop	585	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Pentachaeta lyonii*	Group1	Lyons pentachaeta	586	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Phacelia insularis ssp. insularis*	Group1	Island phacelia	587	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Phlox hirsuta*	Group1	Yreka phlox	588	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Plagiobothrys hirtus*	Group1	rough popcornflower	592	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Plants	*Plagiobothrys strictus*	Group1	Calistoga allocarya	593	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Poa atropurpurea*	Group1	San Bernardino bluegrass	594	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Poa napensis*	Group1	Napa bluegrass	595	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Potentilla hickmanii*	Group1	Hickmans potentilla	596	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA

Table A1. Duplication of results from the native clothianidin MAGtool											
						US EPA Results			***Intrinsik Corp Results***		
Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type Probabilistic or Deterministic***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Plants	*Pseudobahia bahiifolia*	Group1	Hartwegs golden sunburst	599	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Pseudobahia peirsonii*	Group1	San Joaquin adobe sunburst	600	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Schoenocrambe suffrutescens*	Group1	Shrubby reed-mustard	607	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Senecio layneae*	Group1	Laynes butterweed	608	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Sibara filifolia*	Group1	Santa Cruz Island rockcress	609	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Plants	*Sidalcea keckii*	Group1	Kecks Checker-mallow	610	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Sidalcea oregana var. calva*	Group1	Wenatchee Mountains checkermallow	611	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Sidalcea oregana ssp. valida*	Group1	Kenwood Marsh checker-mallow	612	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Plants	*Silene spaldingii*	Group1	Spaldings Catchfly	613	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA

Table A1. Duplication of results from the native clothianidin MAGtool

Taxon	*Scientific Name*	*BE Test Group*	*Common Name*	*Entity ID*	*Analysis Type Probabilistic or Deterministic*	*US EPA Results*			*Intrinsik Corp Results*		
						Source of Species Effects Determination	*Species Call*	*Strength of Call*	*Source of Species Effects Determination*	*Species Call*	*Strength of Call*
Plants	*Taraxacum californicum*	Group1	California taraxacum	614	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Thymophylla tephroleuca*	Group1	Ashy dogweed	615	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Birds	*Gymnogyps californianus*	Birds All	California condor	66	Deterministic	Terr MAGtool	NE	NA	Terr MAGtool	NE	NA
Birds	*Grus americana*	Birds All	Whooping crane	67	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Tympanuchus cupido attwateri*	Birds All	Attwater's greater prairie-chicken	83	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Rallus longirostris yumanensis*	Birds All	Yuma clapper rail	84	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Birds	*Ammodramus maritimus mirabilis*	Birds All	Cape Sable seaside sparrow	85	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Colinus virginianus ridgwayi*	Birds All	Masked bobwhite (quail)	89	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Vermivora bachmanii*	Birds All	Bachman's warbler (=wood)	93	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Sterna antillarum browni*	Birds All	California least tern	96	Deterministic	Terr WoE	NLAA	NA	Terr WoE	NLAA	NA

Table A1. Duplication of results from the native clothianidin MAGtool

Taxon	*Scientific Name*	*BE Test Group*	*Common Name*	*Entity ID*	*Analysis Type Probabilistic or Deterministic*	*US EPA Results*			*Intrinsik Corp Results*		
						Source of Species Effects Determination	*Species Call*	*Strength of Call*	*Source of Species Effects Determination*	*Species Call*	*Strength of Call*
Birds	*Rallus longirostris obsoletus*	Birds All	California clapper rail	102	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Rallus longirostris levipes*	Birds All	Light-footed clapper rail	103	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Birds	*Picoides borealis*	Birds All	Red-cockaded woodpecker	107	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Grus canadensis pulla*	Birds All	Mississippi sandhill crane	110	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Lanius ludovicianus mearnsi*	Birds All	San Clemente loggerhead shrike	115	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Amphispiza belli clementeae*	Birds All	San Clemente sage sparrow	116	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Vireo bellii pusillus*	Birds All	Least Bell's vireo	123	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Mycteria americana*	Birds All	Wood stork	124	Deterministic	Terr MAGtool	NE	NA	Terr MAGtool	NE	NA
Birds	*Polyborus plancus audubonii*	Birds All	Audubon's crested caracara	125	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Falco femoralis septentrionalis*	Birds All	northern aplomado falcon	126	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA

Table A1. Duplication of results from the native clothianidin MAGtool											
Taxon	*Scientific Name*	*BE Test Group*	*Common Name*	*Entity ID*	*Analysis Type Probabilistic or Deterministic*	*US EPA Results*			*Intrinsik Corp Results*		
						Source of Species Effects Determination	*Species Call*	*Strength of Call*	*Source of Species Effects Determination*	*Species Call*	*Strength of Call*
Birds	*Strix occidentalis lucida*	Birds All	Mexican spotted owl	129	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Charadrius melodus*	Birds All	Piping Plover	130	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Charadrius melodus*	Birds All	Piping Plover	131	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Charadrius alexandrinus nivosus*	Birds All	Western snowy plover	132	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Ammodramus savannarum floridanus*	Birds All	Florida grasshopper sparrow	133	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Sterna antillarum*	Birds All	Least tern	134	Deterministic	Terr WoE	NLAA	NA	Terr WoE	NLAA	NA
Birds	*Sterna dougallii dougallii*	Birds All	Roseate tern	135	Deterministic	Terr MAGtool	NE	NA	Terr MAGtool	NE	NA
Birds	*Pipilo crissalis eremophilus*	Birds All	Inyo California towhee	137	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Dendroica chrysoparia*	Birds All	Golden-cheeked warbler (=wood)	139	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Aphelocoma coerulescens*	Birds All	Florida scrub-jay	140	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA

Table A1. Duplication of results from the native clothianidin MAGtool											
						US EPA Results			***Intrinsik Corp Results***		
Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type Probabilistic or Deterministic***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Birds	*Strix occidentalis caurina*	Birds All	Northern spotted owl	142	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Polioptila californica californica*	Birds All	Coastal California gnatcatcher	145	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Empidonax traillii extimus*	Birds All	Southwestern willow flycatcher	149	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Rostrhamus sociabilis plumbeus*	Birds All	Everglade snail kite	1221	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Birds	*Gymnogyps californianus*	Birds All	California condor	1737	Deterministic	Terr MAGtool	NE	NA	Terr MAGtool	NE	NA
Birds	*Centrocercus minimus*	Birds All	Gunnison sage-grouse	4064	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Eremophila alpestris strigata*	Birds All	Streaked Horned lark	4296	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Grus americana*	Birds All	Whooping crane	4679	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Coccyzus americanus*	Birds All	Yellow-billed Cuckoo	6901	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Grus americana*	Birds All	Whooping crane	7342	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA

Table A1. Duplication of results from the native clothianidin MAGtool											
Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type Probabilistic or Deterministic***	***US EPA Results***			***Intrinsik Corp Results***		
						Source of Species Effects Determination	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Birds	*Calidris canutus rufa*	Birds All	Red knot	8621	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Birds	*Falco femoralis septentrionalis*	Birds All	northern aplomado falcon	9122	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Grus americana*	Birds All	Whooping crane	10124	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Aqua. Invert.	*Lampsilis altilis*	Group3n4	Finelined pocketbook	372	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Lampsilis subangulata*	Group3n4	Shinyrayed pocketbook	373	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Epioblasma torulosa rangiana*	Group3n4	Northern riffleshell	374	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Amblema neislerii*	Group3n4	Fat threeridge (mussel)	375	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pleurobema gibberum*	Group3n4	Cumberland pigtoe	376	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pleurobema perovatum*	Group3n4	Ovate clubshell	377	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pleurobema decisum*	Group3n4	Southern clubshell	378	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Ptychobranchus greenii*	Group3n4	Triangular Kidneyshell	379	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Medionidus acutissimus*	Group3n4	Alabama moccasinshell	380	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA

Table A1. Duplication of results from the native clothianidin MAGtool											
Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type Probabilistic or Deterministic***	***US EPA Results***			***Intrinsik Corp Results***		
						Source of Species Effects Determination	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Aqua. Invert.	*Medionidus parvulus*	Group3n4	Coosa moccasinshell	381	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pleurobema furvum*	Group3n4	Dark pigtoe	382	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pleurobema georgianum*	Group3n4	Southern pigtoe	383	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Medionidus penicillatus*	Group3n4	Gulf moccasinshell	384	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Medionidus simpsonianus*	Group3n4	Ochlockonee moccasinshell	385	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Elliptio chipolaensis*	Group3n4	Chipola slabshell	386	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Athearnia anthonyi*	Group3n4	Anthony's riversnail	396	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Taylorconcha serpenticola*	Group3n4	Bliss Rapids snail	398	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Physa natricina*	Group3n4	Snake River physa snail	399	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pyrgulopsis ogmorhaphe*	Group3n4	Royal marstonia (snail)	401	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pyrgulopsis (=Marstonia) pachyta*	Group3n4	Armored snail	402	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Tryonia alamosae*	Group3n4	Alamosa springsnail	403	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pyrgulopsis bruneauensis*	Group3n4	Bruneau Hot springsnail	404	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA

Table A1. Duplication of results from the native clothianidin MAGtool											
						US EPA Results			***Intrinsik Corp Results***		
Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type Probabilistic or Deterministic***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Aqua. Invert.	*Antrobia culveri*	Group3n4	Tumbling Creek cavesnail	406	Deterministic	Aqua WoE	LAA	Weakest evidence of LAA	Aqua WoE	LAA	Weakest evidence of LAA
Aqua. Invert.	*Tulotoma magnifica*	Group3n4	Tulotoma snail	407	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pyrgulopsis neomexicana*	Group3n4	Socorro springsnail	408	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Lanx sp.*	Group3n4	Banbury Springs limpet	409	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Elimia crenatella*	Group3n4	Lacy elimia (snail)	411	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Lioplax cyclostomaformis*	Group3n4	Cylindrical lioplax (snail)	412	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Lepyrium showalteri*	Group3n4	Flat pebblesnail	413	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Leptoxis taeniata*	Group3n4	Painted rocksnail	414	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Leptoxis plicata*	Group3n4	Plicate rocksnail	415	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Leptoxis ampla*	Group3n4	Round rocksnail	416	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Campeloma decampi*	Group3n4	Slender campeloma	417	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Ambrysus amargosus*	Group3n4	Ash Meadows naucorid	439	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA

Table A1. Duplication of results from the native clothianidin MAGtool											
Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type Probabilistic or Deterministic***	***US EPA Results***			***Intrinsik Corp Results***		
						Source of Species Effects Determination	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Aqua. Invert.	*Brychius hungerfordi*	Group3n4	Hungerford's crawling water Beetle	441	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA
Aqua. Invert.	*Heterelmis comalensis*	Group3n4	Comal Springs riffle beetle	453	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA
Aqua. Invert.	*Stygoparnus comalensis*	Group3n4	Comal Springs dryopid beetle	454	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA
Aqua. Invert.	*Stygobromus hayi*	Group3n4	Hay's Spring amphipod	475	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA
Aqua. Invert.	*Antrolana lira*	Group3n4	Madison Cave isopod	476	Deterministic	Aqua WoE	LAA	Weakest evidence of LAA	Aqua WoE	LAA	Weakest evidence of LAA
Aqua. Invert.	*Stygobromus (=Stygonectes) pecki*	Group3n4	Peck's cave amphipod	477	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA
Aqua. Invert.	*Orconectes shoupi*	Group3n4	Nashville crayfish	478	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA
Aqua. Invert.	*Pacifastacus fortis*	Group3n4	Shasta crayfish	479	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA
Aqua. Invert.	*Palaemonias alabamae*	Group3n4	Alabama cave shrimp	480	Deterministic	Aqua WoE	LAA	Weakest evidence of LAA	Aqua WoE	LAA	Weakest evidence of LAA
Aqua. Invert.	*Syncaris pacifica*	Group3n4	California freshwater shrimp	481	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA

Table A1. Duplication of results from the native clothianidin MAGtool

Taxon	*Scientific Name*	*BE Test Group*	*Common Name*	*Entity ID*	*Analysis Type Probabilistic or Deterministic*	*US EPA Results*			*Intrinsik Corp Results*		
						Source of Species Effects Determination	*Species Call*	*Strength of Call*	*Source of Species Effects Determination*	*Species Call*	*Strength of Call*
Aqua. Invert.	*Palaemonias ganteri*	Group3n4	Kentucky cave shrimp	482	Deterministic	Aqua WoE	LAA	Weakest evidence of LAA	Aqua WoE	LAA	Weakest evidence of LAA
Aqua. Invert.	*Thermosphaeroma thermophilus*	Group3n4	Socorro isopod	483	Deterministic	Aqua WoE	**NLAA**	NA	Aqua WoE	**Low population NLAA – needs review**	NA
Aqua. Invert.	*Gammarus acherondytes*	Group3n4	Illinois cave amphipod	484	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA
Aqua. Invert.	*Lirceus usdagalun*	Group3n4	Lee County cave isopod	486	Deterministic	Aqua WoE	LAA	Weakest evidence of LAA	Aqua WoE	LAA	Weakest evidence of LAA
Aqua. Invert.	*Palaemonetes cummingi*	Group3n4	Squirrel Chimney Cave shrimp	487	Deterministic	Aqua WoE	LAA	Weakest evidence of LAA	Aqua WoE	LAA	Weakest evidence of LAA
Aqua. Invert.	*Cambarus zophonastes*	Group3n4	Cave crayfish	488	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA

Aqua. Invert. – Aquatic Invertebrates
Aqua WoE – Aquatic Weight of Evidence
Terr WoE – Terrestrial Weight of Evidence
Terr MAGtool – Terrestrial MAGtool output
Aqua MAGtool – Aquatic MAGtool output
Bold – Difference in output
LAA – Likely to Adversely Affect
NLAA – Not Likely to Adversely Affect
NA – Not Applicable
NE – No Effect

Table A2. Duplication of results from the native imidacloprid MAGtool											
Taxon	*Scientific Name*	*BE Test Group*	*Common Name*	*Entity ID*	*Analysis Type Probabilistic or Deterministic*	*US EPA Results*			*Intrinsik Corp Results*		
						Source of Species Effects Determination	*Species Call*	*Strength of Call*	*Source of Species Effects Determination*	*Species Call*	*Strength of Call*
Plants	*Acanthomintha ilicifolia*	Group 1	San Diego thornmint	496	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Alopecurus aequalis var. sonomensis*	Group 1	Sonoma alopecurus	498	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Ambrosia pumila*	Group 1	San Diego ambrosia	500	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Arabis hoffmannii*	Group 1	Hoffmann's rock-cress	501	Deterministic	Terr WoE	**NLAA**	**NA**	Terr WoE	**LAA**	**Moderate evidence of LAA**
Plants	*Arctostaphylos glandulosa ssp. crassifolia*	Group 1	Del Mar manzanita	502	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Arctostaphylos confertiflora*	Group 1	Santa Rosa Island manzanita	503	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Arctostaphylos myrtifolia*	Group 1	Ione manzanita	504	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Arctostaphylos pallida*	Group 1	Pallid manzanita	505	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Arenaria ursina*	Group 1	Bear Valley sandwort	506	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Astragalus brauntonii*	Group 1	Braunton's milk-vetch	507	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA

Table A2. Duplication of results from the native imidacloprid MAGtool											
Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type Probabilistic or Deterministic***	***US EPA Results***			***Intrinsik Corp Results***		
						Source of Species Effects Determination	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Plants	*Astragalus clarianus*	Group 1	Clara Hunt's milk-vetch	508	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Astragalus jaegerianus*	Group 1	Lane Mountain milk-vetch	510	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Astragalus pycnostachyus var. lanosissimus*	Group 1	Ventura Marsh Milk-vetch	511	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Astragalus tener var. titi*	Group 1	Coastal dunes milk-vetch	512	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Astrophytum asterias*	Group 1	Star cactus	513	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Berberis nevinii*	Group 1	Nevin's barberry	514	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Berberis pinnata ssp. insularis*	Group 1	Island Barberry	515	Deterministic	Terr WoE	**NLAA**	**NA**	Terr WoE	**LAA**	**Weakest evidence of LAA**
Plants	*Brodiaea filifolia*	Group 1	Thread-leaved brodiaea	516	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Brodiaea pallida*	Group 1	Chinese Camp brodiaea	517	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA

Table A2. Duplication of results from the native imidacloprid MAGtool											
Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type Probabilistic or Deterministic***	***US EPA Results***			***Intrinsik Corp Results***		
						Source of Species Effects Determination	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Plants	*Calyptridium pulchellum*	Group 1	Mariposa pussypaws	519	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Calystegia stebbinsii*	Group 1	Stebbins' morning-glory	520	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Carex albida*	Group 1	White sedge	521	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Castilleja campestris ssp. succulenta*	Group 1	Fleshy owl's-clover	522	Deterministic	Terr WoE	LAA	**Moderate evidence of LAA**	Terr WoE	LAA	**Weakest evidence of LAA**
Plants	*Castilleja cinerea*	Group 1	Ash-grey paintbrush	523	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Castilleja mollis*	Group 1	Soft-leaved paintbrush	524	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Ceanothus roderickii*	Group1	Pine Hill ceanothus	525	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Cercocarpus traskiae*	Group1	Catalina Island mountain-mahogany	526	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Chamaesyce hooveri*	Group1	Hoovers spurge	527	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA

Table A2. Duplication of results from the native imidacloprid MAGtool											
Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type Probabilistic or Deterministic***	***US EPA Results***			***Intrinsik Corp Results***		
						Source of Species Effects Determination	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Plants	*Chlorogalum purpureum*	Group1	purple amole	528	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Chorizanthe orcuttiana*	Group1	Orcutts spineflower	529	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Cirsium hydrophilum var. hydrophilum*	Group1	Suisun thistle	530	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Cirsium loncholepis*	Group1	La Graciosa thistle	531	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Clarkia imbricata*	Group1	Vine Hill clarkia	532	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Cordylanthus mollis ssp. mollis*	Group1	Soft birds-beak	534	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Delphinium bakeri*	Group1	Bakers larkspur	539	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Delphinium luteum*	Group1	Yellow larkspur	540	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Dudleya abramsii ssp. parva*	Group1	Conejo dudleya	541	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA

Table A2. Duplication of results from the native imidacloprid MAGtool

Taxon	*Scientific Name*	*BE Test Group*	*Common Name*	*Entity ID*	*Analysis Type Probabilistic or Deterministic*	*US EPA Results*			*Intrinsik Corp Results*		
						Source of Species Effects Determination	*Species Call*	*Strength of Call*	*Source of Species Effects Determination*	*Species Call*	*Strength of Call*
Plants	*Dudleya cymosa ssp. marcescens*	Group1	Marcescent dudleya	542	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Dudleya nesiotica*	Group1	Santa Cruz Island dudleya	543	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Dudleya stolonifera*	Group1	Laguna Beach liveforever	544	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Eriodictyon capitatum*	Group1	Lompoc yerba santa	546	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Eriogonum apricum (incl. var. prostratum)*	Group1	Ione (incl. Irish Hill) buckwheat	547	Deterministic	Terr WoE	LAA	**Moderate evidence of LAA**	Terr WoE	LAA	**Weakest evidence of LAA**
Plants	*Eriogonum kennedyi var. austromontanum*	Group1	Southern mountain wild-buckwheat	548	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Fremontodendron californicum ssp. decumbens*	Group1	Pine Hill flannelbush	550	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Fritillaria gentneri*	Group1	Gentners Fritillary	551	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Galium buxifolium*	Group1	Island bedstraw	552	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA

Table A2. Duplication of results from the native imidacloprid MAGtool											
Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type Probabilistic or Deterministic***	***US EPA Results***			***Intrinsik Corp Results***		
						Source of Species Effects Determination	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Plants	*Galium californicum ssp. sierrae*	Group1	El Dorado bedstraw	553	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Gilia tenuiflora ssp. hoffmannii*	Group1	Hoffmanns slender-flowered gilia	555	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Hackelia venusta*	Group1	Showy stickseed	556	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Helianthemum greenei*	Group1	Island rush-rose	557	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Helianthus paradoxus*	Group1	Pecos (puzzle paradox) sunflower	558	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Deinandra (=Hemizonia) conjugens*	Group1	Otay tarplant	559	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Holocarpha macradenia*	Group1	Santa Cruz tarplant	562	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Lasthenia conjugens*	Group1	Contra Costa goldfields	566	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Lesquerella perforata*	Group1	Spring Creek bladderpod	568	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA

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Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type Probabilistic or Deterministic***	***US EPA Results***			***Intrinsik Corp Results***		
						Source of Species Effects Determination	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Plants	*Lesquerella thamnophila*	Group1	Zapata bladderpod	569	Deterministic	Terr WoE	LAA	**Moderate evidence of LAA**	Terr WoE	LAA	**Weakest evidence of LAA**
Plants	*Lilium pardalinum ssp. pitkinense*	Group1	Pitkin Marsh lily	570	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Plants	*Lithophragma maximum*	Group1	San Clemente Island woodland-star	571	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Lupinus nipomensis*	Group1	Nipomo Mesa lupine	573	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Malacothamnus fasciculatus var. nesioticus*	Group1	Santa Cruz Island bush-mallow	574	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Monardella viminea*	Group1	Willowy monardella	576	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Navarretia leucocephala ssp. pauciflora (=N. pauciflora)*	Group1	Few-flowered navarretia	578	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Navarretia leucocephala ssp. plieantha*	Group1	Many-flowered navarretia	579	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Neostapfia colusana*	Group1	Colusa grass	580	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA

Table A2. Duplication of results from the native imidacloprid MAGtool											
Taxon	*Scientific Name*	*BE Test Group*	*Common Name*	*Entity ID*	*Analysis Type Probabilistic or Deterministic*	*US EPA Results*			*Intrinsik Corp Results*		
						Source of Species Effects Determination	*Species Call*	*Strength of Call*	*Source of Species Effects Determination*	*Species Call*	*Strength of Call*
Plants	*Orcuttia pilosa*	Group1	Hairy Orcutt grass	582	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Plants	*Orcuttia tenuis*	Group1	Slender Orcutt grass	583	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Parvisedum leiocarpum*	Group1	Lake County stonecrop	585	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Pentachaeta lyonii*	Group1	Lyons pentachaeta	586	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Phacelia insularis ssp. insularis*	Group1	Island phacelia	587	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Phlox hirsuta*	Group1	Yreka phlox	588	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Plagiobothrys hirtus*	Group1	rough popcornflower	592	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Plagiobothrys strictus*	Group1	Calistoga allocarya	593	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Poa atropurpurea*	Group1	San Bernardino bluegrass	594	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA

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Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type Probabilistic or Deterministic***	***US EPA Results***			***Intrinsik Corp Results***		
						Source of Species Effects Determination	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Plants	*Poa napensis*	Group1	Napa bluegrass	595	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Potentilla hickmanii*	Group1	Hickmans potentilla	596	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Pseudobahia bahiifolia*	Group1	Hartwegs golden sunburst	599	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Pseudobahia peirsonii*	Group1	San Joaquin adobe sunburst	600	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Schoenocrambe suffrutescens*	Group1	Shrubby reed-mustard	607	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Senecio layneae*	Group1	Laynes butterweed	608	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Sibara filifolia*	Group1	Santa Cruz Island rockcress	609	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Plants	*Sidalcea keckii*	Group1	Kecks Checker-mallow	610	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Sidalcea oregana var. calva*	Group1	Wenatchee Mountains checkermallow	611	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Sidalcea oregana ssp. valida*	Group1	Kenwood Marsh checker-mallow	612	Deterministic	Terr WoE	LAA	**Moderate**	Terr WoE	LAA	**Weakest evidence of LAA**

Table A2. Duplication of results from the native imidacloprid MAGtool											
Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type Probabilistic or Deterministic***	***US EPA Results***			***Intrinsik Corp Results***		
						Source of Species Effects Determination	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
								evidence of LAA			
Plants	*Silene spaldingii*	Group1	Spaldings Catchfly	613	Deterministic	Terr WoE	LAA	**Moderate evidence of LAA**	Terr WoE	LAA	**Weakest evidence of LAA**
Plants	*Taraxacum californicum*	Group1	California taraxacum	614	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Thymophylla tephroleuca*	Group1	Ashy dogweed	615	Deterministic	Terr WoE	LAA	**Moderate evidence of LAA**	Terr WoE	LAA	**Weakest evidence of LAA**
Birds	*Gymnogyps californianus*	BirdsTerrInv	California condor	66	Deterministic	Terr WoE	NLAA	NA	Terr WoE	NLAA	NA
Birds	*Grus americana*	BirdsTerrInv	Whooping crane	67	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Tympanuchus cupido attwateri*	BirdsTerrInv	Attwater's greater prairie-chicken	83	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Rallus longirostris yumanensis*	BirdsTerrInv	Yuma clapper rail	84	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Birds	*Ammodramus maritimus mirabilis*	BirdsTerrInv	Cape Sable seaside sparrow	85	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Colinus virginianus ridgwayi*	BirdsTerrInv	Masked bobwhite (quail)	89	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA

Table A2. Duplication of results from the native imidacloprid MAGtool											
Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type Probabilistic or Deterministic***	***US EPA Results***			***Intrinsik Corp Results***		
						Source of Species Effects Determination	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Birds	*Vermivora bachmanii*	BirdsTerrInv	Bachman's warbler (=wood)	93	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Sterna antillarum browni*	BirdsTerrInv	California least tern	96	Deterministic	Terr WoE	NLAA	NA	Terr WoE	NLAA	NA
Birds	*Rallus longirostris obsoletus*	BirdsTerrInv	California clapper rail	102	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Rallus longirostris levipes*	BirdsTerrInv	Light-footed clapper rail	103	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Birds	*Picoides borealis*	BirdsTerrInv	Red-cockaded woodpecker	107	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Grus canadensis pulla*	BirdsTerrInv	Mississippi sandhill crane	110	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Lanius ludovicianus mearnsi*	BirdsTerrInv	San Clemente loggerhead shrike	115	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Amphispiza belli clementeae*	BirdsTerrInv	San Clemente sage sparrow	116	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Vireo bellii pusillus*	BirdsTerrInv	Least Bell's vireo	123	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Mycteria americana*	BirdsTerrInv	Wood stork	124	Deterministic	Terr WoE	NLAA	NA	Terr MAGtool	NLAA	NA

Table A2. Duplication of results from the native imidacloprid MAGtool											
					Analysis Type	***US EPA Results***			***Intrinsik Corp Results***		
Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Probabilistic or Deterministic***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Birds	*Polyborus plancus audubonii*	BirdsTerrInv	Audubon's crested caracara	125	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Falco femoralis septentrionalis*	BirdsTerrInv	northern aplomado falcon	126	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Strix occidentalis lucida*	BirdsTerrInv	Mexican spotted owl	129	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Charadrius melodus*	BirdsTerrInv	Piping Plover	130	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Charadrius melodus*	BirdsTerrInv	Piping Plover	131	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Charadrius alexandrinus nivosus*	BirdsTerrInv	Western snowy plover	132	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Ammodramus savannarum floridanus*	BirdsTerrInv	Florida grasshopper sparrow	133	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Sterna antillarum*	BirdsTerrInv	Least tern	134	Deterministic	Terr WoE	NLAA	NA	Terr WoE	NLAA	NA
Birds	*Pipilo crissalis eremophilus*	BirdsTerrInv	Inyo California towhee	137	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Dendroica chrysoparia*	BirdsTerrInv	Golden-cheeked warbler (=wood)	139	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA

Table A2. Duplication of results from the native imidacloprid MAGtool

Taxon	Scientific Name	BE Test Group	Common Name	Entity ID	Analysis Type Probabilistic or Deterministic	US EPA Results			Intrinsik Corp Results		
						Source of Species Effects Determination	Species Call	Strength of Call	Source of Species Effects Determination	Species Call	Strength of Call
Birds	*Aphelocoma coerulescens*	BirdsTerrInv	Florida scrub-jay	140	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Strix occidentalis caurina*	BirdsTerrInv	Northern spotted owl	142	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Polioptila californica californica*	BirdsTerrInv	Coastal California gnatcatcher	145	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Empidonax traillii extimus*	BirdsTerrInv	Southwestern willow flycatcher	149	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Rostrhamus sociabilis plumbeus*	BirdsTerrInv	Everglade snail kite	1221	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Birds	*Gymnogyps californianus*	BirdsTerrInv	California condor	1737	Deterministic	Terr WoE	NLAA	NA	Terr WoE	NLAA	NA
Birds	*Centrocercus minimus*	BirdsTerrInv	Gunnison sage-grouse	4064	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Eremophila alpestris strigata*	BirdsTerrInv	Streaked Horned lark	4296	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Grus americana*	BirdsTerrInv	Whooping crane	4679	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Coccyzus americanus*	BirdsTerrInv	Yellow-billed Cuckoo	6901	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA

Table A2. Duplication of results from the native imidacloprid MAGtool

Taxon	Scientific Name	BE Test Group	Common Name	Entity ID	Analysis Type Probabilistic or Deterministic	US EPA Results			Intrinsik Corp Results		
						Source of Species Effects Determination	Species Call	Strength of Call	Source of Species Effects Determination	Species Call	Strength of Call
Birds	*Grus americana*	BirdsTerrInv	Whooping crane	7342	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Calidris canutus rufa*	BirdsTerrInv	Red knot	8621	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Birds	*Falco femoralis septentrionalis*	BirdsTerrInv	northern aplomado falcon	9122	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Grus americana*	BirdsTerrInv	Whooping crane	10124	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Aqua. Invert.	*Villosa trabalis*	Group1	Cumberland bean (pearlymussel)	317	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Villosa perpurpurea*	Group1	Purple bean	318	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Epioblasma obliquata obliquata*	Group1	Purple Cat's paw (=Purple Cat's paw pearlymussel)	323	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Epioblasma obliquata perobliqua*	Group1	White catspaw (pearlymussel)	324	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Lampsilis higginsii*	Group1	Higgins eye (pearlymussel)	325	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Lampsilis virescens*	Group1	Alabama lampmussel	326	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA

Table A2. Duplication of results from the native imidacloprid MAGtool											
Taxon	*Scientific Name*	*BE Test Group*	*Common Name*	*Entity ID*	*Analysis Type Probabilistic or Deterministic*	*US EPA Results*			*Intrinsik Corp Results*		
						Source of Species Effects Determination	*Species Call*	*Strength of Call*	*Source of Species Effects Determination*	*Species Call*	*Strength of Call*
Aqua. Invert.	*Toxolasma cylindrellus*	Group1	Pale lilliput (pearlymussel)	327	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Quadrula fragosa*	Group1	Winged Mapleleaf	328	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Quadrula sparsa*	Group1	Appalachian monkeyface (pearlymussel)	329	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Quadrula intermedia*	Group1	Cumberland monkeyface (pearlymussel)	330	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Lampsilis abrupta*	Group1	Pink mucket (pearlymussel)	331	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Lemiox rimosus*	Group1	Birdwing pearlymussel	332	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Epioblasma florentina curtisii*	Group1	Curtis pearlymussel	333	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Dromus dromas*	Group1	Dromedary pearlymussel	334	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pegias fabula*	Group1	Littlewing pearlymussel	335	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Plethobasus cicatricosus*	Group1	White wartyback (pearlymussel)	336	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Fusconaia cuneolus*	Group1	Finerayed pigtoe	337	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pleurobema plenum*	Group1	Rough pigtoe	338	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Fusconaia cor*	Group1	Shiny pigtoe	339	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA

Table A2. Duplication of results from the native imidacloprid MAGtool											
					Analysis Type	***US EPA Results***			***Intrinsik Corp Results***		
Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Probabilistic or Deterministic***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Aqua. Invert.	*Plethobasus cooperianus*	Group1	Orangefoot pimpleback (pearlymussel)	340	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Obovaria retusa*	Group1	Ring pink (mussel)	341	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Potamilus capax*	Group1	Fat pocketbook	342	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Arkansia wheeleri*	Group1	Ouachita rock pocketbook	343	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Quadrula cylindrica strigillata*	Group1	Rough rabbitsfoot	344	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Leptodea leptodon*	Group1	Scaleshell mussel	345	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Epioblasma florentina walkeri (=E. walkeri)*	Group1	Tan riffleshell	346	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pleurobema curtum*	Group1	Black clubshell	347	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Epioblasma penita*	Group1	Southern combshell	348	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pleurobema taitianum*	Group1	Heavy pigtoe	350	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Elliptio steinstansana*	Group1	Tar River spinymussel	351	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pleurobema clava*	Group1	Clubshell	352	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Epioblasma brevidens*	Group1	Cumberlandian combshell	353	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA

Table A2. Duplication of results from the native imidacloprid MAGtool											
Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type***	***US EPA Results***			***Intrinsik Corp Results***		
					Probabilistic or Deterministic	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Aqua. Invert.	*Alasmidonta raveneliana*	Group1	Appalachian elktoe	354	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Alasmidonta atropurpurea*	Group1	Cumberland elktoe	355	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Potamilus inflatus*	Group1	Alabama (=inflated) heelsplitter	356	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Lampsilis perovalis*	Group1	Orangenacre mucket	357	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Epioblasma capsaeformis*	Group1	Oyster mussel	358	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Hemistena lata*	Group1	Cracking pearlymussel	359	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Lampsilis streckeri*	Group1	Speckled pocketbook	360	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pleurobema collina*	Group1	James spinymussel	361	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Quadrula stapes*	Group1	Stirrupshell	362	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Alasmidonta heterodon*	Group1	Dwarf wedgemussel	363	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Margaritifera hembeli*	Group1	Louisiana pearlshell	364	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Epioblasma othcaloogensis*	Group1	Southern acornshell	365	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Elliptoideus sloatianus*	Group1	Purple bankclimber (mussel)	366	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA

Table A2. Duplication of results from the native imidacloprid MAGtool											
Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type Probabilistic or Deterministic***	***US EPA Results***			***Intrinsik Corp Results***		
						Source of Species Effects Determination	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Aqua. Invert.	*Epioblasma metastriata*	Group1	Upland combshell	367	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Cyprogenia stegaria*	Group1	Fanshell	368	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Lampsilis powellii*	Group1	Arkansas fatmucket	369	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Lasmigona decorata*	Group1	Carolina heelsplitter	370	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pleurobema pyriforme*	Group1	Oval pigtoe	371	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Lampsilis altilis*	Group1	Finelined pocketbook	372	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Lampsilis subangulata*	Group1	Shinyrayed pocketbook	373	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Epioblasma torulosa rangiana*	Group1	Northern riffleshell	374	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Amblema neislerii*	Group1	Fat threeridge (mussel)	375	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pleurobema gibberum*	Group1	Cumberland pigtoe	376	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pleurobema perovatum*	Group1	Ovate clubshell	377	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pleurobema decisum*	Group1	Southern clubshell	378	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Ptychobranchus greenii*	Group1	Triangular Kidneyshell	379	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA

Table A2. Duplication of results from the native imidacloprid MAGtool											
Taxon	*Scientific Name*	*BE Test Group*	*Common Name*	*Entity ID*	*Analysis Type Probabilistic or Deterministic*	*US EPA Results*			*Intrinsik Corp Results*		
						Source of Species Effects Determination	*Species Call*	*Strength of Call*	*Source of Species Effects Determination*	*Species Call*	*Strength of Call*
Aqua. Invert.	*Medionidus acutissimus*	Group1	Alabama moccasinshell	380	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Medionidus parvulus*	Group1	Coosa moccasinshell	381	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pleurobema furvum*	Group1	Dark pigtoe	382	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pleurobema georgianum*	Group1	Southern pigtoe	383	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Medionidus penicillatus*	Group1	Gulf moccasinshell	384	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Medionidus simpsonianus*	Group1	Ochlockonee moccasinshell	385	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Elliptio chipolaensis*	Group1	Chipola slabshell	386	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Athearnia anthonyi*	Group1	Anthony's riversnail	396	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Taylorconcha serpenticola*	Group1	Bliss Rapids snail	398	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Physa natricina*	Group1	Snake River physa snail	399	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pyrgulopsis ogmorhaphe*	Group1	Royal marstonia (snail)	401	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pyrgulopsis (=Marstonia) pachyta*	Group1	Armored snail	402	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Tryonia alamosae*	Group1	Alamosa springsnail	403	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA

Table A2. Duplication of results from the native imidacloprid MAGtool											
Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type Probabilistic or Deterministic***	***US EPA Results***			***Intrinsik Corp Results***		
						Source of Species Effects Determination	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Aqua. Invert.	*Pyrgulopsis bruneauensis*	Group1	Bruneau Hot springsnail	404	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Antrobia culveri*	Group1	Tumbling Creek cavesnail	406	Deterministic	Aqua WoE	LAA	Weakest evidence of LAA	Aqua WoE	LAA	Weakest evidence of LAA
Aqua. Invert.	*Tulotoma magnifica*	Group1	Tulotoma snail	407	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pyrgulopsis neomexicana*	Group1	Socorro springsnail	408	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Lanx sp.*	Group1	Banbury Springs limpet	409	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Elimia crenatella*	Group1	Lacy elimia (snail)	411	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Lioplax cyclostomaformis*	Group1	Cylindrical lioplax (snail)	412	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Lepyrium showalteri*	Group1	Flat pebblesnail	413	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Leptoxis taeniata*	Group1	Painted rocksnail	414	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Leptoxis plicata*	Group1	Plicate rocksnail	415	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Leptoxis ampla*	Group1	Round rocksnail	416	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Campeloma decampi*	Group1	Slender campeloma	417	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA

Table A2. Duplication of results from the native imidacloprid MAGtool											
Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type Probabilistic or Deterministic***	***US EPA Results***			***Intrinsik Corp Results***		
						Source of Species Effects Determination	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Aqua. Invert.	*Ambrysus amargosus*	Group1	Ash Meadows naucorid	439	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA
Aqua. Invert.	*Brychius hungerfordi*	Group1	Hungerford's crawling water Beetle	441	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA
Aqua. Invert.	*Heterelmis comalensis*	Group1	Comal Springs riffle beetle	453	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA
Aqua. Invert.	*Stygoparnus comalensis*	Group1	Comal Springs dryopid beetle	454	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA
Aqua. Invert.	*Stygobromus hayi*	Group1	Hay's Spring amphipod	475	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA
Aqua. Invert.	*Antrolana lira*	Group1	Madison Cave isopod	476	Deterministic	Aqua WoE	LAA	Weakest evidence of LAA	Aqua WoE	LAA	Weakest evidence of LAA
Aqua. Invert.	*Stygobromus (=Stygonectes) pecki*	Group1	Peck's cave amphipod	477	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA
Aqua. Invert.	*Orconectes shoupi*	Group1	Nashville crayfish	478	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA
Aqua. Invert.	*Pacifastacus fortis*	Group1	Shasta crayfish	479	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA
Aqua. Invert.	*Palaemonias alabamae*	Group1	Alabama cave shrimp	480	Deterministic	Aqua WoE	LAA	Weakest evidence of LAA	Aqua WoE	LAA	Weakest evidence of LAA

Table A2. Duplication of results from the native imidacloprid MAGtool											
Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type Probabilistic or Deterministic***	***US EPA Results***			***Intrinsik Corp Results***		
						Source of Species Effects Determination	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Aqua. Invert.	*Syncaris pacifica*	Group1	California freshwater shrimp	481	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA
Aqua. Invert.	*Palaemonias ganteri*	Group1	Kentucky cave shrimp	482	Deterministic	Aqua WoE	LAA	Weakest evidence of LAA	Aqua WoE	LAA	Weakest evidence of LAA
Aqua. Invert.	*Thermosphaeroma thermophilus*	Group1	Socorro isopod	483	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA
Aqua. Invert.	*Gammarus acherondytes*	Group1	Illinois cave amphipod	484	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA
Aqua. Invert.	*Lirceus usdagalun*	Group1	Lee County cave isopod	486	Deterministic	Aqua WoE	LAA	Weakest evidence of LAA	Aqua WoE	LAA	Weakest evidence of LAA

Aqua. Invert. – Aquatic Invertebrates
Aqua WoE – Aquatic Weight of Evidence
Terr WoE – Terrestrial Weight of Evidence
Terr MAGtool – Terrestrial MAGtool output
Aqua MAGtool – Aquatic MAGtool output
Bold – Difference in output
LAA – Likely to Adverse Affect
NLAA – Not Likely to Adversely Affect
NA – Not Applicable
NE – No Effect

Table A3. Duplication of results from the native thiamethoxam MAGtool

Taxon	*Scientific Name*	*BE Test Group*	*Common Name*	*Entity ID*	*Analysis Type Probabilistic or Deterministic*	*US EPA Results*			*Intrinsik Corp Results*		
						Source of Species Effects Determination	*Species Call*	*Strength of Call*	*Source of Species Effects Determination*	*Species Call*	*Strength of Call*
Plants	*Acanthomintha ilicifolia*	Group 1	San Diego thornmint	496	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Alopecurus aequalis var. sonomensis*	Group 1	Sonoma alopecurus	498	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Ambrosia pumila*	Group 1	San Diego ambrosia	500	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Arabis hoffmannii*	Group 1	Hoffmann's rock-cress	501	Deterministic	Terr WoE	NLAA	NA	Terr WoE	NLAA	NA
Plants	*Arctostaphylos glandulosa ssp. crassifolia*	Group 1	Del Mar manzanita	502	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Arctostaphylos confertiflora*	Group 1	Santa Rosa Island manzanita	503	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Arctostaphylos myrtifolia*	Group 1	Ione manzanita	504	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Arctostaphylos pallida*	Group 1	Pallid manzanita	505	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA

Table A3. Duplication of results from the native thiamethoxam MAGtool

Taxon	Scientific Name	BE Test Group	Common Name	Entity ID	Analysis Type Probabilistic or Deterministic	US EPA Results			Intrinsik Corp Results		
						Source of Species Effects Determination	Species Call	Strength of Call	Source of Species Effects Determination	Species Call	Strength of Call
Plants	*Arenaria ursina*	Group 1	Bear Valley sandwort	506	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Astragalus brauntonii*	Group 1	Braunton's milk-vetch	507	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Astragalus clarianus*	Group 1	Clara Hunt's milk-vetch	508	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Astragalus jaegerianus*	Group 1	Lane Mountain milk-vetch	510	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Astragalus pycnostachyus var. lanosissimus*	Group 1	Ventura Marsh Milk-vetch	511	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Astragalus tener var. titi*	Group 1	Coastal dunes milk-vetch	512	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Astrophytum asterias*	Group 1	Star cactus	513	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Berberis nevinii*	Group 1	Nevin's barberry	514	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Berberis pinnata ssp. insularis*	Group 1	Island Barberry	515	Deterministic	Terr MAGtool	NLAA	NA	Terr MAGtool	NLAA	NA
Plants	*Brodiaea filifolia*	Group 1	Thread-leaved brodiaea	516	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA

Table A3. Duplication of results from the native thiamethoxam MAGtool											
Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type Probabilistic or Deterministic***	***US EPA Results***			***Intrinsik Corp Results***		
						Source of Species Effects Determination	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Plants	*Brodiaea pallida*	Group 1	Chinese Camp brodiaea	517	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Plants	*Calyptridium pulchellum*	Group 1	Mariposa pussypaws	519	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Calystegia stebbinsii*	Group 1	Stebbins' morning-glory	520	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Plants	*Carex albida*	Group 1	White sedge	521	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Castilleja campestris ssp. succulenta*	Group 1	Fleshy owl's-clover	522	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Castilleja cinerea*	Group 1	Ash-grey paintbrush	523	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Castilleja mollis*	Group 1	Soft-leaved paintbrush	524	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Ceanothus roderickii*	Group1	Pine Hill ceanothus	525	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Cercocarpus traskiae*	Group1	Catalina Island mountain-mahogany	526	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA

Table A3. Duplication of results from the native thiamethoxam MAGtool

Taxon	*Scientific Name*	*BE Test Group*	*Common Name*	*Entity ID*	*Analysis Type Probabilistic or Deterministic*	*US EPA Results*			*Intrinsik Corp Results*		
						Source of Species Effects Determination	*Species Call*	*Strength of Call*	*Source of Species Effects Determination*	*Species Call*	*Strength of Call*
Plants	*Chamaesyce hooveri*	Group1	Hoovers spurge	527	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Chlorogalum purpureum*	Group1	purple amole	528	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Chorizanthe orcuttiana*	Group1	Orcutts spineflower	529	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Cirsium hydrophilum var. hydrophilum*	Group1	Suisun thistle	530	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Cirsium loncholepis*	Group1	La Graciosa thistle	531	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Plants	*Clarkia imbricata*	Group1	Vine Hill clarkia	532	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Cordylanthus mollis ssp. mollis*	Group1	Soft birds-beak	534	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Delphinium bakeri*	Group1	Bakers larkspur	539	Deterministic	Terr WoE	NLAA	NA	Terr WoE	NLAA	NA
Plants	*Delphinium luteum*	Group1	Yellow larkspur	540	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Dudleya abramsii ssp. parva*	Group1	Conejo dudleya	541	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA

Table A3. Duplication of results from the native thiamethoxam MAGtool											
						US EPA Results			***Intrinsik Corp Results***		
Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type Probabilistic or Deterministic***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Plants	*Dudleya cymosa ssp. marcescens*	Group1	Marcescent dudleya	542	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Dudleya nesiotica*	Group1	Santa Cruz Island dudleya	543	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Dudleya stolonifera*	Group1	Laguna Beach liveforever	544	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Eriodictyon capitatum*	Group1	Lompoc yerba santa	546	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Eriogonum apricum (incl. var. prostratum)*	Group1	Ione (incl. Irish Hill) buckwheat	547	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Plants	*Eriogonum kennedyi var. austromontanum*	Group1	Southern mountain wild-buckwheat	548	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Fremontodendron californicum ssp. decumbens*	Group1	Pine Hill flannelbush	550	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Fritillaria gentneri*	Group1	Gentners Fritillary	551	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Plants	*Galium buxifolium*	Group1	Island bedstraw	552	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Galium californicum ssp. sierrae*	Group1	El Dorado bedstraw	553	Deterministic	Terr WoE	LAA	Weakest	Terr WoE	LAA	Weakest evidence of LAA

Table A3. Duplication of results from the native thiamethoxam MAGtool

Taxon	*Scientific Name*	*BE Test Group*	*Common Name*	*Entity ID*	*Analysis Type Probabilistic or Deterministic*	*US EPA Results*			*Intrinsik Corp Results*		
						Source of Species Effects Determination	*Species Call*	*Strength of Call*	*Source of Species Effects Determination*	*Species Call*	*Strength of Call*
								evidence of LAA			
Plants	*Gilia tenuiflora ssp. hoffmannii*	Group1	Hoffmanns slender-flowered gilia	555	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Hackelia venusta*	Group1	Showy stickseed	556	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Helianthemum greenei*	Group1	Island rush-rose	557	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Helianthus paradoxus*	Group1	Pecos (puzzle paradox) sunflower	558	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Deinandra (=Hemizonia) conjugens*	Group1	Otay tarplant	559	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Holocarpha macradenia*	Group1	Santa Cruz tarplant	562	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Lasthenia conjugens*	Group1	Contra Costa goldfields	566	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Plants	*Lesquerella perforata*	Group1	Spring Creek bladderpod	568	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Lesquerella thamnophila*	Group1	Zapata bladderpod	569	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA

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Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type Probabilistic or Deterministic***	***US EPA Results***			***Intrinsik Corp Results***		
						Source of Species Effects Determination	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Plants	*Lilium pardalinum ssp. pitkinense*	Group1	Pitkin Marsh lily	570	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Plants	*Lithophragma maximum*	Group1	San Clemente Island woodland-star	571	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Lupinus nipomensis*	Group1	Nipomo Mesa lupine	573	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Malacothamnus fasciculatus var. nesioticus*	Group1	Santa Cruz Island bush-mallow	574	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Monardella viminea*	Group1	Willowy monardella	576	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Navarretia leucocephala ssp. pauciflora (=N. pauciflora)*	Group1	Few-flowered navarretia	578	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Navarretia leucocephala ssp. plieantha*	Group1	Many-flowered navarretia	579	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Neostapfia colusana*	Group1	Colusa grass	580	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Orcuttia pilosa*	Group1	Hairy Orcutt grass	582	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA

Table A3. Duplication of results from the native thiamethoxam MAGtool											
						US EPA Results			***Intrinsik Corp Results***		
Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type Probabilistic or Deterministic***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Plants	*Orcuttia tenuis*	Group1	Slender Orcutt grass	583	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Parvisedum leiocarpum*	Group1	Lake County stonecrop	585	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Pentachaeta lyonii*	Group1	Lyons pentachaeta	586	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Phacelia insularis ssp. insularis*	Group1	Island phacelia	587	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Phlox hirsuta*	Group1	Yreka phlox	588	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Plagiobothrys hirtus*	Group1	rough popcornflower	592	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Plants	*Plagiobothrys strictus*	Group1	Calistoga allocarya	593	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Poa atropurpurea*	Group1	San Bernardino bluegrass	594	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Poa napensis*	Group1	Napa bluegrass	595	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA

Table A3. Duplication of results from the native thiamethoxam MAGtool											
Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type Probabilistic or Deterministic***	***US EPA Results***			***Intrinsik Corp Results***		
						Source of Species Effects Determination	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Plants	*Potentilla hickmanii*	Group1	Hickmans potentilla	596	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Pseudobahia bahiifolia*	Group1	Hartwegs golden sunburst	599	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Pseudobahia peirsonii*	Group1	San Joaquin adobe sunburst	600	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Schoenocrambe suffrutescens*	Group1	Shrubby reed-mustard	607	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Senecio layneae*	Group1	Laynes butterweed	608	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Sibara filifolia*	Group1	Santa Cruz Island rockcress	609	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Plants	*Sidalcea keckii*	Group1	Kecks Checker-mallow	610	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Sidalcea oregana var. calva*	Group1	Wenatchee Mountains checkermallow	611	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Sidalcea oregana ssp. valida*	Group1	Kenwood Marsh checker-mallow	612	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA

Table A3. Duplication of results from the native thiamethoxam MAGtool

Taxon	*Scientific Name*	*BE Test Group*	*Common Name*	*Entity ID*	*Analysis Type Probabilistic or Deterministic*	*US EPA Results*			*Intrinsik Corp Results*		
						Source of Species Effects Determination	*Species Call*	*Strength of Call*	*Source of Species Effects Determination*	*Species Call*	*Strength of Call*
Plants	*Silene spaldingii*	Group1	Spaldings Catchfly	613	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Plants	*Taraxacum californicum*	Group1	California taraxacum	614	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Plants	*Thymophylla tephroleuca*	Group1	Ashy dogweed	615	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Birds	*Gymnogyps californianus*	Birds All	California condor	66	Deterministic	Terr MAGtool	NE	NA	Terr MAGtool	NE	NA
Birds	*Grus americana*	Birds All	Whooping crane	67	Deterministic	Terr WoE	LAA	**Weakest evidence of LAA**	Terr WoE	LAA	**Moderate evidence of LAA**
Birds	*Tympanuchus cupido attwateri*	Birds All	Attwater's greater prairie-chicken	83	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Rallus longirostris yumanensis*	Birds All	Yuma clapper rail	84	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Birds	*Ammodramus maritimus mirabilis*	Birds All	Cape Sable seaside sparrow	85	Deterministic	Terr WoE	LAA	**Weakest evidence of LAA**	Terr WoE	LAA	**Moderate evidence of LAA**
Birds	*Colinus virginianus ridgwayi*	Birds All	Masked bobwhite (quail)	89	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Vermivora bachmanii*	Birds All	Bachman's warbler (=wood)	93	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA

Table A3. Duplication of results from the native thiamethoxam MAGtool											
Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type Probabilistic or Deterministic***	***US EPA Results***			***Intrinsik Corp Results***		
						Source of Species Effects Determination	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Birds	*Sterna antillarum browni*	Birds All	California least tern	96	Deterministic	Terr MAGtool	NE	NA	Terr MAGtool	NE	NA
Birds	*Rallus longirostris obsoletus*	Birds All	California clapper rail	102	Deterministic	Terr WoE	LAA	**Weakest evidence of LAA**	Terr WoE	LAA	**Moderate evidence of LAA**
Birds	*Rallus longirostris levipes*	Birds All	Light-footed clapper rail	103	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Birds	*Picoides borealis*	Birds All	Red-cockaded woodpecker	107	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Grus canadensis pulla*	Birds All	Mississippi sandhill crane	110	Deterministic	Terr WoE	LAA	**Weakest evidence of LAA**	Terr WoE	LAA	**Moderate evidence of LAA**
Birds	*Lanius ludovicianus mearnsi*	Birds All	San Clemente loggerhead shrike	115	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Amphispiza belli clementeae*	Birds All	San Clemente sage sparrow	116	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Vireo bellii pusillus*	Birds All	Least Bell's vireo	123	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Mycteria americana*	Birds All	Wood stork	124	Deterministic	Terr MAGtool	NE	NA	Terr MAGtool	NE	NA
Birds	*Polyborus plancus audubonii*	Birds All	Audubon's crested caracara	125	Deterministic	Terr WoE	LAA	**Weakest evidence of LAA**	Terr WoE	LAA	**Moderate evidence of LAA**

Table A3. Duplication of results from the native thiamethoxam MAGtool											
						US EPA Results			***Intrinsik Corp Results***		
Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type Probabilistic or Deterministic***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Birds	*Falco femoralis septentrionalis*	Birds All	northern aplomado falcon	126	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Strix occidentalis lucida*	Birds All	Mexican spotted owl	129	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Charadrius melodus*	Birds All	Piping Plover	130	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Birds	*Charadrius melodus*	Birds All	Piping Plover	131	Deterministic	Terr WoE	LAA	**Weakest evidence of LAA**	Terr WoE	LAA	**Moderate evidence of LAA**
Birds	*Charadrius alexandrinus nivosus*	Birds All	Western snowy plover	132	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Ammodramus savannarum floridanus*	Birds All	Florida grasshopper sparrow	133	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Sterna antillarum*	Birds All	Least tern	134	Deterministic	Terr MAGtool	NE	NA	Terr MAGtool	NE	NA
Birds	*Pipilo crissalis eremophilus*	Birds All	Inyo California towhee	137	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Dendroica chrysoparia*	Birds All	Golden-cheeked warbler (=wood)	139	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Aphelocoma coerulescens*	Birds All	Florida scrub-jay	140	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA

Table A3. Duplication of results from the native thiamethoxam MAGtool											
Taxon	*Scientific Name*	*BE Test Group*	*Common Name*	*Entity ID*	*Analysis Type Probabilistic or Deterministic*	*US EPA Results*			*Intrinsik Corp Results*		
						Source of Species Effects Determination	*Species Call*	*Strength of Call*	*Source of Species Effects Determination*	*Species Call*	*Strength of Call*
Birds	*Strix occidentalis caurina*	Birds All	Northern spotted owl	142	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Polioptila californica californica*	Birds All	Coastal California gnatcatcher	145	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Empidonax traillii extimus*	Birds All	Southwestern willow flycatcher	149	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Rostrhamus sociabilis plumbeus*	Birds All	Everglade snail kite	1221	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Birds	*Gymnogyps californianus*	Birds All	California condor	1737	Deterministic	Terr MAGtool	NE	NA	Terr MAGtool	NE	NA
Birds	*Centrocercus minimus*	Birds All	Gunnison sage-grouse	4064	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Eremophila alpestris strigata*	Birds All	Streaked Horned lark	4296	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Grus americana*	Birds All	Whooping crane	4679	Deterministic	Terr WoE	LAA	**Weakest evidence of LAA**	Terr WoE	LAA	**Moderate evidence of LAA**
Birds	*Coccyzus americanus*	Birds All	Yellow-billed Cuckoo	6901	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Grus americana*	Birds All	Whooping crane	7342	Deterministic	Terr WoE	LAA	**Weakest evidence of LAA**	Terr WoE	LAA	**Moderate evidence of LAA**

Table A3. Duplication of results from the native thiamethoxam MAGtool											
Taxon	*Scientific Name*	*BE Test Group*	*Common Name*	*Entity ID*	*Analysis Type Probabilistic or Deterministic*	*US EPA Results*			*Intrinsik Corp Results*		
						Source of Species Effects Determination	*Species Call*	*Strength of Call*	*Source of Species Effects Determination*	*Species Call*	*Strength of Call*
Birds	*Calidris canutus rufa*	Birds All	Red knot	8621	Deterministic	Terr WoE	LAA	Weakest evidence of LAA	Terr WoE	LAA	Weakest evidence of LAA
Birds	*Falco femoralis septentrionalis*	Birds All	northern aplomado falcon	9122	Deterministic	Terr WoE	LAA	Moderate evidence of LAA	Terr WoE	LAA	Moderate evidence of LAA
Birds	*Grus americana*	Birds All	Whooping crane	10124	Deterministic	Terr WoE	LAA	**Weakest evidence of LAA**	Terr WoE	LAA	**Moderate evidence of LAA**
Aqua. Invert.	*Villosa trabalis*	Group1-4	Cumberland bean (pearlymussel)	317	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Villosa perpurpurea*	Group1-4	Purple bean	318	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Epioblasma obliquata obliquata*	Group1-4	Purple Cat's paw (=Purple Cat's paw pearlymussel)	323	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Epioblasma obliquata perobliqua*	Group1-4	White catspaw (pearlymussel)	324	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Lampsilis higginsii*	Group1-4	Higgins eye (pearlymussel)	325	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Lampsilis virescens*	Group1-4	Alabama lampmussel	326	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Toxolasma cylindrellus*	Group1-4	Pale lilliput (pearlymussel)	327	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Quadrula fragosa*	Group1-4	Winged Mapleleaf	328	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA

Table A3. Duplication of results from the native thiamethoxam MAGtool

Taxon	Scientific Name	BE Test Group	Common Name	Entity ID	Analysis Type Probabilistic or Deterministic	US EPA Results			Intrinsik Corp Results		
						Source of Species Effects Determination	Species Call	Strength of Call	Source of Species Effects Determination	Species Call	Strength of Call
Aqua. Invert.	*Quadrula sparsa*	Group1-4	Appalachian monkeyface (pearlymussel)	329	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Quadrula intermedia*	Group1-4	Cumberland monkeyface (pearlymussel)	330	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Lampsilis abrupta*	Group1-4	Pink mucket (pearlymussel)	331	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Lemiox rimosus*	Group1-4	Birdwing pearlymussel	332	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Epioblasma florentina curtisii*	Group1-4	Curtis pearlymussel	333	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Dromus dromas*	Group1-4	Dromedary pearlymussel	334	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pegias fabula*	Group1-4	Littlewing pearlymussel	335	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Plethobasus cicatricosus*	Group1-4	White wartyback (pearlymussel)	336	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Fusconaia cuneolus*	Group1-4	Finerayed pigtoe	337	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pleurobema plenum*	Group1-4	Rough pigtoe	338	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Fusconaia cor*	Group1-4	Shiny pigtoe	339	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Plethobasus cooperianus*	Group1-4	Orangefoot pimpleback (pearlymussel)	340	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA

Table A3. Duplication of results from the native thiamethoxam MAGtool

Taxon	Scientific Name	BE Test Group	Common Name	Entity ID	Analysis Type Probabilistic or Deterministic	US EPA Results			Intrinsik Corp Results		
						Source of Species Effects Determination	Species Call	Strength of Call	Source of Species Effects Determination	Species Call	Strength of Call
Aqua. Invert.	*Obovaria retusa*	Group1-4	Ring pink (mussel)	341	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Potamilus capax*	Group1-4	Fat pocketbook	342	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Arkansia wheeleri*	Group1-4	Ouachita rock pocketbook	343	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Quadrula cylindrica strigillata*	Group1-4	Rough rabbitsfoot	344	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Leptodea leptodon*	Group1-4	Scaleshell mussel	345	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Epioblasma florentina walkeri (=E. walkeri)*	Group1-4	Tan riffleshell	346	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pleurobema curtum*	Group1-4	Black clubshell	347	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Epioblasma penita*	Group1-4	Southern combshell	348	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pleurobema taitianum*	Group1-4	Heavy pigtoe	350	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Elliptio steinstansana*	Group1-4	Tar River spinymussel	351	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pleurobema clava*	Group1-4	Clubshell	352	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Epioblasma brevidens*	Group1-4	Cumberlandian combshell	353	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Alasmidonta raveneliana*	Group1-4	Appalachian elktoe	354	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA

Table A3. Duplication of results from the native thiamethoxam MAGtool

Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type Probabilistic or Deterministic***	***US EPA Results***			***Intrinsik Corp Results***		
						Source of Species Effects Determination	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Aqua. Invert.	*Alasmidonta atropurpurea*	Group1-4	Cumberland elktoe	355	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Potamilus inflatus*	Group1-4	Alabama (=inflated) heelsplitter	356	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Lampsilis perovalis*	Group1-4	Orangenacre mucket	357	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Epioblasma capsaeformis*	Group1-4	Oyster mussel	358	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Hemistena lata*	Group1-4	Cracking pearlymussel	359	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Lampsilis streckeri*	Group1-4	Speckled pocketbook	360	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pleurobema collina*	Group1-4	James spinymussel	361	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Quadrula stapes*	Group1-4	Stirrupshell	362	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Alasmidonta heterodon*	Group1-4	Dwarf wedgemussel	363	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Margaritifera hembeli*	Group1-4	Louisiana pearlshell	364	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Epioblasma othcaloogensis*	Group1-4	Southern acornshell	365	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Elliptoideus sloatianus*	Group1-4	Purple bankclimber (mussel)	366	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Epioblasma metastriata*	Group1-4	Upland combshell	367	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA

Table A3. Duplication of results from the native thiamethoxam MAGtool											
Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type Probabilistic or Deterministic***	***US EPA Results***			***Intrinsik Corp Results***		
						Source of Species Effects Determination	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Aqua. Invert.	*Cyprogenia stegaria*	Group1-4	Fanshell	368	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Lampsilis powellii*	Group1-4	Arkansas fatmucket	369	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Lasmigona decorata*	Group1-4	Carolina heelsplitter	370	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pleurobema pyriforme*	Group1-4	Oval pigtoe	371	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Lampsilis altilis*	Group1-4	Finelined pocketbook	372	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Lampsilis subangulata*	Group1-4	Shinyrayed pocketbook	373	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Epioblasma torulosa rangiana*	Group1-4	Northern riffleshell	374	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Amblema neislerii*	Group1-4	Fat threeridge (mussel)	375	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pleurobema gibberum*	Group1-4	Cumberland pigtoe	376	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pleurobema perovatum*	Group1-4	Ovate clubshell	377	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pleurobema decisum*	Group1-4	Southern clubshell	378	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Ptychobranchus greenii*	Group1-4	Triangular Kidneyshell	379	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Medionidus acutissimus*	Group1-4	Alabama moccasinshell	380	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA

Table A3. Duplication of results from the native thiamethoxam MAGtool

Taxon	*Scientific Name*	*BE Test Group*	*Common Name*	*Entity ID*	*Analysis Type Probabilistic or Deterministic*	*US EPA Results*			*Intrinsik Corp Results*		
						Source of Species Effects Determination	*Species Call*	*Strength of Call*	*Source of Species Effects Determination*	*Species Call*	*Strength of Call*
Aqua. Invert.	*Medionidus parvulus*	Group1-4	Coosa moccasinshell	381	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pleurobema furvum*	Group1-4	Dark pigtoe	382	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pleurobema georgianum*	Group1-4	Southern pigtoe	383	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Medionidus penicillatus*	Group1-4	Gulf moccasinshell	384	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Medionidus simpsonianus*	Group1-4	Ochlockonee moccasinshell	385	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Elliptio chipolaensis*	Group1-4	Chipola slabshell	386	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Athearnia anthonyi*	Group1-4	Anthony's riversnail	396	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Taylorconcha serpenticola*	Group1-4	Bliss Rapids snail	398	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Physa natricina*	Group1-4	Snake River physa snail	399	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pyrgulopsis ogmorhaphe*	Group1-4	Royal marstonia (snail)	401	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pyrgulopsis (=Marstonia) pachyta*	Group1-4	Armored snail	402	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Tryonia alamosae*	Group1-4	Alamosa springsnail	403	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pyrgulopsis bruneauensis*	Group1-4	Bruneau Hot springsnail	404	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA

Table A3. Duplication of results from the native thiamethoxam MAGtool

Taxon	*Scientific Name*	*BE Test Group*	*Common Name*	*Entity ID*	*Analysis Type Probabilistic or Deterministic*	*US EPA Results*			*Intrinsik Corp Results*		
						Source of Species Effects Determination	*Species Call*	*Strength of Call*	*Source of Species Effects Determination*	*Species Call*	*Strength of Call*
Aqua. Invert.	*Antrobia culveri*	Group1-4	Tumbling Creek cavesnail	406	Deterministic	Aqua WoE	LAA	Weakest evidence of LAA	Aqua WoE	LAA	Weakest evidence of LAA
Aqua. Invert.	*Tulotoma magnifica*	Group1-4	Tulotoma snail	407	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Pyrgulopsis neomexicana*	Group1-4	Socorro springsnail	408	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Lanx sp.*	Group1-4	Banbury Springs limpet	409	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Elimia crenatella*	Group1-4	Lacy elimia (snail)	411	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Lioplax cyclostomaformis*	Group1-4	Cylindrical lioplax (snail)	412	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Lepyrium showalteri*	Group1-4	Flat pebblesnail	413	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Leptoxis taeniata*	Group1-4	Painted rocksnail	414	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Leptoxis plicata*	Group1-4	Plicate rocksnail	415	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Leptoxis ampla*	Group1-4	Round rocksnail	416	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Campeloma decampi*	Group1-4	Slender campeloma	417	Deterministic	Aqua MAGtool	NE	NA	Aqua MAGtool	NE	NA
Aqua. Invert.	*Ambrysus amargosus*	Group1-4	Ash Meadows naucorid	439	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA

Table A3. Duplication of results from the native thiamethoxam MAGtool											
Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type Probabilistic or Deterministic***	***US EPA Results***			***Intrinsik Corp Results***		
						Source of Species Effects Determination	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Aqua. Invert.	*Brychius hungerfordi*	Group1-4	Hungerford's crawling water Beetle	441	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA
Aqua. Invert.	*Heterelmis comalensis*	Group1-4	Comal Springs riffle beetle	453	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA
Aqua. Invert.	*Stygoparnus comalensis*	Group1-4	Comal Springs dryopid beetle	454	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA
Aqua. Invert.	*Stygobromus hayi*	Group1-4	Hay's Spring amphipod	475	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA
Aqua. Invert.	*Antrolana lira*	Group1-4	Madison Cave isopod	476	Deterministic	Aqua WoE	LAA	Weakest evidence of LAA	Aqua WoE	LAA	Weakest evidence of LAA
Aqua. Invert.	*Stygobromus (=Stygonectes) pecki*	Group1-4	Peck's cave amphipod	477	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA
Aqua. Invert.	*Orconectes shoupi*	Group1-4	Nashville crayfish	478	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA
Aqua. Invert.	*Pacifastacus fortis*	Group1-4	Shasta crayfish	479	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA
Aqua. Invert.	*Palaemonias alabamae*	Group1-4	Alabama cave shrimp	480	Deterministic	Aqua WoE	LAA	Weakest evidence of LAA	Aqua WoE	LAA	Weakest evidence of LAA
Aqua. Invert.	*Syncaris pacifica*	Group1-4	California freshwater shrimp	481	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA

Table A3. Duplication of results from the native thiamethoxam MAGtool											
Taxon	***Scientific Name***	***BE Test Group***	***Common Name***	***Entity ID***	***Analysis Type Probabilistic or Deterministic***	***US EPA Results***			***Intrinsik Corp Results***		
						Source of Species Effects Determination	***Species Call***	***Strength of Call***	***Source of Species Effects Determination***	***Species Call***	***Strength of Call***
Aqua. Invert.	*Palaemonias ganteri*	Group1-4	Kentucky cave shrimp	482	Deterministic	Aqua WoE	LAA	Weakest evidence of LAA	Aqua WoE	LAA	Weakest evidence of LAA
Aqua. Invert.	*Thermosphaeroma thermophilus*	Group1-4	Socorro isopod	483	Deterministic	Aqua WoE	**NLAA**	NA	Aqua WoE	**Low population NLAA – needs review**	NA
Aqua. Invert.	*Gammarus acherondytes*	Group1-4	Illinois cave amphipod	484	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA
Aqua. Invert.	*Lirceus usdagalun*	Group1-4	Lee County cave isopod	486	Deterministic	Aqua WoE	LAA	Weakest evidence of LAA	Aqua WoE	LAA	Weakest evidence of LAA
Aqua. Invert.	*Palaemonetes cummingi*	Group1-4	Squirrel Chimney Cave shrimp	487	Deterministic	Aqua WoE	LAA	Weakest evidence of LAA	Aqua WoE	LAA	Weakest evidence of LAA
Aqua. Invert.	*Cambarus zophonastes*	Group1-4	Cave crayfish	488	Deterministic	Aqua WoE	LAA	Moderate evidence of LAA	Aqua WoE	LAA	Moderate evidence of LAA

Aqua. Invert. – Aquatic Invertebrates
Aqua WoE – Aquatic Weight of Evidence
Terr WoE – Terrestrial Weight of Evidence
Terr MAGtool – Terrestrial MAGtool output
Aqua MAGtool – Aquatic MAGtool output
Bold – Difference in output
LAA – Likely to Adverse Effect
NLAA – Not Likely to Adversely Affect
NA – Not Applicable
NE – No Effect

Table A4. Multiplication factors applied to benchmark parameters in the MAGtool toxicity inputs worksheet to change the species call from LAA to NLAA or NE for the three neonic pesticides

Pesticide:	**Clothianidin**			**Imidacloprid**					**Thiamethoxam**		
Multiplication Factor:	**1,000x**	**10,000x**	**100,000x**	**1,000x**	**10,000x**	**100,000x**	**1,000,000x**	**10,000,000x**	**1,000x**	**10,000x**	**100,000x**
Plant species:											
Thread-leaved brodiaea Entity ID 416	LAA (Weakest)	LAA (Weakest)	NE	LAA (Weakest)	LAA (Weakest)	NE	-	-	LAA (Weakest)	LAA (Weakest)	NE
San Diego thornmint Entity ID 496	LAA (Weakest)	LAA (Weakest)	NE	LAA (Weakest)	LAA (Weakest)	NE	-	-	LAA (Weakest)	LAA (Weakest)	NE
Terrestrial Invertebrate species:											
Valley elderberry longhorn beetle Entity ID 436	LAA (Weakest)	LAA (Weakest)	NE	LAA (Moderate)	LAA (Moderate)	LAA (Weakest)	LAA (Weakest)	NE	LAA (Moderate)	LAA (Moderate)	NLAA (NA)
American burying beetle Entity ID 440	LAA (Moderate)	LAA (Moderate)	NE	LAA (Moderate)	LAA (Moderate)	LAA (Weakest)	NE	NE	LAA (Moderate)	LAA (Moderate)	NE

LAA – Likely to Adverse Effect

NLAA – Not Likely to Adversely Affect

NE – No Effect

"- "– Not investigated

Appendix 2.1. Species range maps with LAA determination in draft thiamethoxam BE that got updated and changed their areas between June 2020 to April 2021 downloads

Taxa	Common (*Sci.*) Name	Sp. ID	Species Call?	Region: CONUS; NL48; Both	Area Change %
Mammals	Carolina northern flying squirrel (*Glaucomys sabrinus coloratus*)	42	LAA	CONUS	-89.3%
Mammals	Anastasia Island beach mouse (*Peromyscus polionotus phasma*)	50	LAA	CONUS	-68.1%
Mammals	Florida salt marsh vole (*Microtus pennsylvanicus dukecampbelli*)	60	LAA	CONUS	47.9%
Birds	Northern spotted owl (*Strix occidentalis caurina*)	142	LAA	CONUS	3.2%
Reptiles	Eastern indigo snake (*Drymarchon corais couperi*)	173	LAA	CONUS	2.5%
Reptiles	American crocodile (*Crocodylus acutus*)	176	LAA	CONUS	580.9%
Fish	Fountain darter (*Etheostoma fonticola*)	228	LAA	CONUS	613.2%
Fish	Duskytail darter (*Etheostoma percnurum*)	308	LAA	CONUS	-80.7%
Terrestrial Invertebrates	El Segundo blue butterfly (*Euphilotes battoides allyni*)	419	LAA	CONUS	-96.7%
Terrestrial Invertebrates	Mission blue butterfly *(Icaricia icarioides missionensis*)	423	LAA	CONUS	-57.4%
Terrestrial Invertebrates	Myrtle's silverspot butterfly (*Speyeria zerene myrtleae*)	425	LAA	CONUS	-71.4%
Terrestrial Invertebrates	San Bruno elfin butterfly (*Callophrys mossii bayensis*)	427	LAA	CONUS	-99.5%
Terrestrial Invertebrates	Callippe silverspot butterfly (*Speyeria callippe callippe*)	430	LAA	CONUS	-87.0%
Terrestrial Invertebrates	Bay checkerspot butterfly (*Euphydryas editha bayensis*)	438	LAA	CONUS	-96.7%
Terrestrial Invertebrates	Northeastern beach tiger beetle (*Cicindela dorsalis dorsalis*)	442	LAA	CONUS	-0.5%

Taxa	Common (*Sci.*) Name	Sp. ID	Species Call?	Region: CONUS; NL48; Both	Area Change %
Terrestrial Invertebrates	Behren's silverspot butterfly (*Speyeria zerene behrensii*)	444	LAA	CONUS	-74.5%
Aquatic Invertebrates	Comal Springs riffle beetle (*Heterelmis comalensis*)	453	LAA	CONUS	613.2%
Aquatic Invertebrates	Comal Springs dryopid beetle (*Stygoparnus comalensis*)	454	LAA	CONUS	613.2%
Terrestrial Invertebrates	Saint Francis' satyr butterfly (*Neonympha mitchellii francisci*)	455	LAA	CONUS	-68.2%
Aquatic Invertebrates	Peck's cave amphipod (*Stygobromus (=Stygonectes) pecki*)	477	LAA	CONUS	1438.3%
Aquatic Invertebrates	Benton County cave crayfish (*Cambarus aculabrum*)	489	LAA	CONUS	-40.9%
Plants	No common name (*Achyranthes mutica*)	497	LAA	NL48	-73.9%
Plants	Uhi uhi (*Mezoneuron kavaiense*)	518	LAA	NL48	-91.1%
Plants	Vine Hill clarkia (*Clarkia imbricata*)	532	LAA	CONUS	-80.6%
Plants	Laguna Beach liveforever (*Dudleya stolonifera*)	544	LAA	CONUS	3.0%
Plants	Calistoga allocarya (*Plagiobothrys strictus*)	593	LAA	CONUS	-83.9%
Plants	Napa bluegrass (*Poa napensis*)	595	LAA	CONUS	-83.9%
Plants	No common name (*Abutilon eremitopetalum*)	616	LAA	NL48	-91.5%
Plants	Liliwai (Acaena exigua)	619	LAA	NL48	-100.0%
Plants	Mahoe (*Alectryon macrococcus*)	621	LAA	NL48	-73.3%
Plants	Mauna Loa (=Ka'u) silversword (*Argyroxiphium kauense*)	634	LAA	NL48	-94.0%
Plants	`Ahinahina (*Argyroxiphium sandwicense ssp. macrocephalum*)	635	LAA	NL48	-98.7%
Plants	Ash meadows milk-vetch (*Astragalus phoenix*)	641	LAA	CONUS	-96.2%
Plants	Coyote ceanothus (Ceanothus ferrisae)	658	LAA	CONUS	-54.2%
Plants	'Akoko (Euphorbia halemanui)	664	LAA	NL48	-0.1%

Taxa	Common (*Sci.*) Name	Sp. ID	Species Call?	Region: CONUS; NL48; Both	Area Change %
Plants	Haha (*Cyanea grimesiana ssp. grimesiana*)	684	LAA	NL48	-8.3%
Plants	Arizona hedgehog cactus (*Echinocereus triglochidiatus var. arizonicus*)	703	LAA	CONUS	-55.5%
Plants	Small whorled pogonia (*Isotria medeoloides*)	742	LAA	CONUS	21.6%
Plants	Ash Meadows ivesia (*Ivesia kingii var. eremica*)	743	LAA	CONUS	-96.2%
Plants	Barneby ridge-cress (*Lepidium barnebyanum*)	749	LAA	CONUS	9.3%
Plants	Kodachrome bladderpod (*Lesquerella tumulosa*)	751	LAA	CONUS	-29.0%
Plants	No common name (*Lipochaeta venosa*)	757	LAA	NL48	-97.3%
Plants	Ash Meadows blazingstar (*Mentzelia leucophylla*)	776	LAA	CONUS	40.5%
Plants	No common name (Polyscias racemosa)	778	LAA	NL48	-88.2%
Plants	Peebles Navajo cactus (*Pediocactus peeblesianus var. peeblesianus*)	793	LAA	CONUS	-66.1%
Plants	No common name (*Tetramolopium lepidotum ssp. lepidotum*)	848	LAA	NL48	-0.1%
Plants	\`Ohe\`ohe (*Polyscias gymnocarpa*)	851	LAA	NL48	-0.1%
Plants	\`Ahinahina (*Argyroxiphium sandwicense ssp. sandwicense*)	882	LAA	NL48	-17.2%
Plants	Ash Meadows sunray (*Enceliopsis nudicaulis var. corrugata*)	926	LAA	CONUS	-96.3%
Plants	Ash Meadows gumplant (*Grindelia fraxinipratensis*)	941	LAA	CONUS	40.5%
Plants	Nehe (*Lipochaeta waimeaensis*)	964	LAA	NL48	-99.9%
Plants	Holmgren milk-vetch (*Astragalus holmgreniorum*)	1020	LAA	CONUS	-78.5%
Plants	Alabama leather flower (*Clematis socialis*)	1048	LAA	CONUS	-73.2%

Taxa	Common (*Sci.*) Name	Sp. ID	Species Call?	Region: CONUS; NL48; Both	Area Change %
Plants	Haha (*Cyanea grimesiana ssp. obatae*)	1049	LAA	NL48	-99.1%
Plants	Mountain golden heather (*Hudsonia montana*)	1058	LAA	CONUS	-98.0%
Plants	No common name (*Schiedea spergulina var. leiopoda*)	1069	LAA	NL48	-0.1%
Plants	No common name (*Schiedea spergulina var. spergulina*)	1070	LAA	NL48	-80.3%
Plants	\`Akoko (*Euphorbia kuwaleana*)	1094	LAA	NL48	-0.2%
Plants	kopa (*Kadua cordata remyi*)	1118	LAA	NL48	-0.1%
Plants	Lo\`ulu (*Pritchardia maideniana*)	1142	LAA	NL48	-0.5%
Plants	\`Anunu (*Sicyos albus*)	1151	LAA	NL48	-0.1%
Plants	Big-leaved crownbeard (*Verbesina dissita*)	1173	LAA	CONUS	-70.3%
Plants	\`Akoko (*Euphorbia herbstii*)	1179	LAA	NL48	-0.3%
Plants	\`Akoko (*Euphorbia rockii*)	1180	LAA	NL48	-0.4%
Plants	\`Akoko (*Euphorbia deppeana*)	1223	LAA	NL48	-0.2%
Plants	Kamakahala (*Labordia tinifolia var. lanaiensis*)	1232	LAA	NL48	-0.1%
Plants	\`Akoko (*Euphorbia eleanoriae*)	1502	LAA	NL48	-0.2%
Plants	Bracted twistflower (*Streptanthus bracteatus*)	1678	LAA	CONUS	-2.0%
Plants	\`Ohe (*Joinvillea ascendens ascendens*)	1709	LAA	NL48	-0.1%
Plants	Kopiko (*Psychotria hexandra ssp. oahuensis*)	3084	LAA	NL48	-0.2%
Reptiles	Louisiana pine snake (*Pituophis ruthveni*)	3722	LAA	CONUS	-79.8%
Plants	No common name (*Platydesma cornuta var. decurrens*)	7046	LAA	NL48	-73.7%
Plants	Kentucky glade cress (*Leavenworthia exigua laciniata*)	7167	LAA	CONUS	-82.7%
Plants	No common name (*Platydesma cornuta var. cornuta*)	8303	LAA	NL48	-26.4%

Taxa	Common (*Sci.*) Name	Sp. ID	Species Call?	Region: CONUS; NL48; Both	Area Change %
Plants	Pariette cactus (*Sclerocactus brevispinus*)	9338	LAA	CONUS	-40.6%
Fish	Panama City crayfish (*Procambarus econfinae*)	9386	LAA	CONUS	-97.4%
Plants	No common name (*Polyscias flynnii*)	9961	LAA	NL48	-0.7%
Plants	Uinta Basin hookless cactus (*Sclerocactus wetlandicus*)	10034	LAA	CONUS	-46.1%
Plants	kookoolau (*Bidens hillebrandiana ssp. hillebrandiana*)	10479	LAA	NL48	-86.9%
Plants	No common name (*Schiedea diffusa ssp. macraei*)	10483	LAA	NL48	-0.1%
Plants	No common name (*Schiedea diffusa subsp. diffusa*)	10591	LAA	NL48	-69.0%
Birds	Eastern Black rail *(Laterallus jamaicensis ssp. jamaicensis*)	11319	LAA	Both	4.7%

Note: negative 'area change %' indicate the updated species data decreased in area, and vice versa

Appendix 2.2. Species critical habitats with LAA determination in draft thiamethoxam BE that got updated and changed their areas between June 2020 to April 2021 downloads

Taxa	Common (*Sci.*) Name	Sp.ID	Critical Habitat Call?	Region: CONUS; NL48; Both	Area Change %
Aquatic Invertebrates	Kauai cave amphipod (*Spelaeorchestia koloana*)	485	LAA	NL48	-1%
Plants	No common name (*Phyllostegia parviflora*)	591	LAA	NL48	-3%
Plants	No common name (*Sanicula purpurea*)	601	LAA	NL48	2034%
Plants	No common name (*Schiedea hookeri*)	602	LAA	NL48	-79%
Plants	Ma`oli`oli (*Schiedea kealiae*)	603	LAA	NL48	-30%
Plants	No common name (*Schiedea obovata*)	622	LAA	NL48	-24%
Plants	No common name (*Schiedea trinervis*)	623	LAA	NL48	-71%
Plants	Kuahiwi laukahi (*Plantago princeps*)	800	LAA	NL48	258%
Plants	Po`e (*Portulaca sclerocarpa*)	806	LAA	NL48	1274%
Plants	No common name (*Schiedea kaalae*)	822	LAA	NL48	-65%
Plants	No common name (*Silene lanceolata*)	830	LAA	NL48	17%
Plants	Popolo ku mai (*Solanum incompletum*)	832	LAA	NL48	10%
Plants	`Aiakeakua popolo (*Solanum sandwicense*)	833	LAA	NL48	83%
Plants	No common name (*Stenogyne kanehoana*)	839	LAA	NL48	-25%
Plants	No common name (*Tetramolopium filiforme*)	847	LAA	NL48	-17%
Plants	No common name (*Tetramolopium lepidotum ssp. lepidotum*)	848	LAA	NL48	-24%†
Plants	`Ohe`ohe (*Polyscias gymnocarpa*)	851	LAA	NL48	-18%†
Plants	No common name (*Phyllostegia mollis*)	981	LAA	NL48	-91%
Plants	No common name (*Platanthera holochila*)	983	LAA	NL48	115%
Plants	Ohai (*Sesbania tomentosa*)	999	LAA	NL48	12%
Plants	Kuahiwi laukahi (*Plantago hawaiensis*)	1140	LAA	NL48	42%
Plants	No common name (*Sanicula mariversa*)	1146	LAA	NL48	-24%

Taxa	Common (*Sci.*) Name	Sp.ID	Critical Habitat Call?	Region: CONUS; NL48; Both	Area Change %
Plants	No common name (*Schiedea nuttallii*)	1148	LAA	NL48	9%
Plants	No common name (*Silene perlmanii*)	1152	LAA	NL48	-24%
Plants	No common name (*Spermolepis hawaiiensis*)	1154	LAA	NL48	9%
Plants	No common name (*Phyllostegia kaalaensis*)	1184	LAA	NL48	-24%
Plants	Kaulu (*Pteralyxia macrocarpa*)	2265	LAA	NL48	-1%
Plants	Kopiko (*Psychotria hexandra ssp. oahuensis*)	3084	LAA	NL48	-3%†
Plants	Hala pepe (*Pleomele forbesii*)	3737	LAA	NL48	-9%
Amphibians	Georgetown Salamander (*Eurycea naufragia*)	5434	LAA	CONUS	-29%
Birds	Yellow-billed Cuckoo (*Coccyzus americanus*)	6901	LAA	CONUS	-40%
Plants	No common name (*Platydesma cornuta var. decurrens*)	7046	LAA	NL48	-24%†
Plants	No common name (*Polyscias lydgatei*)	7367	LAA	NL48	-75%
Amphibians	Salado Salamander (*Eurycea chisholmensis*)	7610	LAA	CONUS	111%
Plants	No common name (*Platydesma cornuta var. cornuta*)	8303	LAA	NL48	-3%†

† Areas of species range also changed (see **Appendix 3.1**)

Note: negative 'area change %' indicate the updated species data decreased in area, and vice versa

Appendix 3.1 Thiamethoxam Concentrations in Streams of Highly Vulnerable Watersheds

Daily thiamethoxam concentration at Site MO-08					
Date	**Concentration, ppb**	**Date**	**Concentration, ppb**	**Date**	**Concentration, ppb**
3/28/21	0.0094	5/12/21	0.0282	6/23/21	0.1616
4/1/21	0.0025	5/13/21	0.0298	6/24/21	0.1347
4/2/21	0.0062	5/14/21	0.0270	6/25/21	0.1557
4/3/21	0.0025	5/15/21	0.0214	6/26/21	0.2083
4/4/21	0.0025	5/16/21	0.0211	6/27/21	0.2040
4/5/21	0.0025	5/17/21	0.1041	6/28/21	0.1847
4/6/21	0.0051	5/18/21	0.2190	6/29/21	0.2283
4/7/21	0.0025	5/19/21	0.1808	6/30/21	0.1258
4/8/21	0.0201	5/20/21	0.1492	7/1/21	0.1335
4/9/21	0.0132	5/21/21	0.1462	7/2/21	0.1160
4/10/21	0.0205	5/22/21	0.1535	7/3/21	0.0851
4/11/21	0.0131	5/23/21	0.1364	7/4/21	0.0682
4/12/21	0.0058	5/24/21	0.1173	7/5/21	0.0662
4/13/21	0.0065	5/25/21	0.1080	7/6/21	0.0576
4/14/21	0.0025	5/26/21	0.0887	7/7/21	0.0495
4/15/21	0.0077	5/27/21	0.0952	7/8/21	0.0568
4/16/21	0.0066	5/28/21	0.0992	7/9/21	0.0461
4/17/21	0.0025	5/29/21	0.1103	7/10/21	0.0897
4/18/21	0.0025	5/30/21	0.0746	7/11/21	0.1433
4/19/21	0.0025	5/31/21	0.0641	7/12/21	0.1278
4/20/21	0.0065	6/1/21	0.0670	7/13/21	0.0866
4/21/21	0.0025	6/2/21	0.0630	7/14/21	0.0776
4/22/21	0.0050	6/3/21	0.0634	7/15/21	0.0778
4/23/21	0.0025	6/4/21	0.0549	7/16/21	0.0660
4/24/21	0.0025	6/5/21	0.0463	7/17/21	0.1110
4/25/21	0.0025	6/6/21	0.0481	7/18/21	0.0924
4/26/21	0.0025	6/7/21	0.0496	7/19/21	0.0828
4/27/21	0.0025	6/8/21	0.0377	7/20/21	0.0637
4/28/21	0.0025	6/9/21	0.0355	7/21/21	0.0664
4/29/21	0.0691	6/10/21	0.0320	7/22/21	0.0685
4/30/21	0.0397	6/11/21	0.0341	7/23/21	0.0633
5/1/21	0.0175	6/12/21	0.0323	7/24/21	0.0561
5/2/21	0.0139	6/13/21	0.0342	7/25/21	0.0594
5/3/21	0.0113	6/14/21	0.0365	7/26/21	0.0543
5/4/21	0.0099	6/15/21	0.0345	7/27/21	0.0372
5/5/21	0.0080	6/16/21	0.0255	7/28/21	0.0438
5/6/21	0.0096	6/17/21	0.0253	7/29/21	0.0438

Daily thiamethoxam concentration at Site MO-08					
Date	**Concentration, ppb**	**Date**	**Concentration, ppb**	**Date**	**Concentration, ppb**
5/7/21	0.0089	6/18/21	0.0253	7/30/21	0.0496
5/8/21	0.0092	6/19/21	0.0238	7/31/21	0.0469
5/9/21	0.0096	6/20/21	0.4147	8/1/21	0.0470
5/10/21	0.0554	6/21/21	0.2653	8/2/21	0.0434
5/11/21	0.0603	6/22/21	0.2591		

Daily thiamethoxam concentration at Site NE-04					
Date	Concentration, ppb	Date	Concentration, ppb	Date	Concentration, ppb
3/28/21	0.0053	5/11/21	0.0059	6/23/21	0.0396
3/30/21	0.0025	5/12/21	0.0025	6/24/21	0.0587
4/1/21	0.0025	5/13/21	0.0056	6/25/21	0.0613
4/2/21	0.0025	5/14/21	0.0054	6/26/21	0.0605
4/3/21	0.0025	5/15/21	0.0072	6/27/21	0.0841
4/4/21	0.0025	5/16/21	0.0103	6/28/21	0.0849
4/5/21	0.0025	5/17/21	0.0081	6/29/21	0.0588
4/6/21	0.0025	5/18/21	0.0054	6/30/21	0.0520
4/7/21	0.0053	5/19/21	0.0025	7/2/21	0.0362
4/8/21	0.0123	5/20/21	0.0050	7/3/21	0.0346
4/9/21	0.0079	5/21/21	0.0025	7/4/21	0.0172
4/10/21	0.0056	5/22/21	0.0068	7/5/21	0.0133
4/11/21	0.0076	5/23/21	0.0025	7/6/21	0.0156
4/12/21	0.0069	5/24/21	0.0025	7/7/21	0.0092
4/13/21	0.0059	5/25/21	0.0025	7/8/21	0.0120
4/14/21	0.0056	5/26/21	0.0025	7/9/21	0.0111
4/15/21	0.0056	5/27/21	0.0025	7/10/21	0.0370
4/16/21	0.0025	5/28/21	0.0072	7/11/21	0.0366
4/17/21	0.0025	5/29/21	0.1010	7/12/21	0.0387
4/18/21	0.0025	5/30/21	0.2528	7/13/21	0.0290
4/19/21	0.0025	5/31/21	0.2777	7/14/21	0.0182
4/20/21	0.0025	6/1/21	0.1553	7/15/21	0.0478
4/21/21	0.0025	6/2/21	0.1266	7/16/21	0.0352
4/22/21	0.0025	6/3/21	0.1204	7/17/21	0.0157
4/23/21	0.0025	6/4/21	0.1172	7/18/21	0.0232
4/24/21	0.0025	6/5/21	0.1225	7/20/21	0.0223
4/25/21	0.0025	6/6/21	0.1178	7/21/21	0.0228
4/26/21	0.0025	6/7/21	0.1265	7/22/21	0.0181
4/27/21	0.0025	6/8/21	0.0557	7/29/21	0.0327
4/28/21	0.0025	6/9/21	0.0717	7/30/21	0.0396
4/29/21	0.0025	6/10/21	0.1004	7/31/21	0.0225
4/30/21	0.0025	6/11/21	0.0257	8/1/21	0.0246
5/1/21	0.0025	6/12/21	0.0393	8/2/21	0.0325
5/2/21	0.0025	6/14/21	0.0982		
5/3/21	0.0076	6/15/21	0.0314		
5/4/21	0.0057	6/16/21	0.0387		
5/5/21	0.0025	6/17/21	0.0783		

Daily thiamethoxam concentration at Site NE-04					
Date	**Concentration, ppb**	**Date**	**Concentration, ppb**	**Date**	**Concentration, ppb**
5/6/21	0.0055	6/18/21	0.0396		
5/7/21	0.0025	6/19/21	0.0201		
5/8/21	0.0025	6/20/21	0.0171		
5/9/21	0.0066	6/21/21	0.0410		
5/10/21	0.0079	6/22/21	0.0773		

Appendix 3.2. Thiamethoxam and Clothianidin Concentrations Measured in Surface Water (Pond) in Missouri

Date	Thiamethoxam (ppb)	Clothianidin (ppb)	Date	Thiamethoxam (ppb)	Clothianidin (ppb)
6/7/21	0.003	0.147	7/13/21	1.220	0.284
6/8/21	0.003	0.131	7/14/21	1.164	0.271
6/9/21	0.003	0.135	7/15/21	1.016	0.256
6/10/21	0.003	0.127	7/16/21	0.982	0.265
6/11/21	0.003	0.132	7/17/21	0.892	0.241
6/12/21	0.003	0.114	7/18/21	0.857	0.231
6/13/21	0.003	0.120	7/19/21	0.746	0.229
6/14/21	0.003	0.112	7/20/21	0.658	0.218
6/15/21	0.003	0.110	7/21/21	0.623	0.222
6/16/21	0.003	0.107	7/22/21	0.588	0.220
6/17/21	0.003	0.094	7/23/21	0.519	0.196
6/18/21	0.003	0.089	7/24/21	0.468	0.191
6/19/21	0.003	0.086	7/25/21	0.403	0.192
6/20/21	0.207	0.111	7/26/21	0.353	0.182
6/21/21	0.803	0.179	7/27/21	0.330	0.184
6/22/21	1.002	0.205	7/28/21	0.303	0.172
6/23/21	0.981	0.211	7/29/21	0.247	0.171
6/24/21	0.926	0.189	7/30/21	0.199	0.173
6/25/21	1.275	0.260	7/31/21	0.190	0.167
6/26/21	1.717	0.312	8/1/21	0.230	0.156
6/27/21	1.803	0.344	8/2/21	0.214	0.154
6/28/21	1.835	0.339	8/3/21	0.187	0.152
6/29/21	1.993	0.387	8/4/21	0.145	0.138
6/30/21	2.031	0.406	8/5/21	0.116	0.147
7/1/21	2.008	0.400	8/6/21	0.115	0.140
7/2/21	2.020	0.409	8/8/21	0.074	0.125
7/3/21	1.936	0.386	8/11/21	0.041	0.120
7/4/21	1.846	0.381	8/15/21	0.018	0.101
7/5/21	1.821	0.375	8/18/21	0.007	0.084
7/6/21	1.677	0.372	8/22/21	0.003	0.068
7/7/21	1.601	0.350	8/25/21	0.003	0.051
7/8/21	1.584	0.341	8/29/21	0.003	0.042
7/9/21	1.495	0.323	9/1/21	0.009	0.043
7/10/21	1.345	0.305	9/5/21	0.024	0.040
7/11/21	1.245	0.292	9/8/21	0.027	0.039
7/12/21	1.213	0.275	9/12/21	0.020	0.035

Appendix 3.3. Site Maintenance Pesticide and Seed Treatment History at the Missouri Pond Study Location

Year	Crop	Crop Variety / Relative Maturity Days (RM)	Seed Treatment
2017	Corn	Pfister 3366RASS / 112 RM Pfister 2770SS / 114 RM (replant)	Thiamethoxam, Fludioxonil, Mefenoxam, Azoxystrobin, and Thiabendazole
2018	Soybeans	Producers Hybrids Xtend / 3.8 RM (dicamba-tolerant) 38114NSRX	Redigo 480® [Prothioconazole], Allegiance FL® [Metalaxyl], and Gaucho 600® [Imidacloprid]
2019	Soybeans	NuTech 3444L Liberty Link / 4.4 RM Same variety planted each time.	ILEVO® [Fluopyram, 2-(trifluoromethyl) benzamide]
2020	Corn	Unknown	Poncho® 500 [Clothianidin]
2021	Soybeans	AgriSoy Enlist E3, Variety: E3428	CruiserMaxx Vibrance® [Thiamethoxam, Mefenoxam, Fludioxonil]; Saltro [Pydiflumetofen]

Appendix 4.0. Indirect Effects

Comments on the Draft Biological Evaluation for Thiamethoxam

TEST GUIDELINE

Not Applicable

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DATE COMPLETED

October 25th, 2021

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EXECUTIVE SUMMARY

The US Environmental Protection Agency (EPA) recently released the draft Biological Evaluation (BE) for threatened and endangered species potentially exposed to thiamethoxam. In the draft BE, the Agency assigned May Affect/Likely to Adversely Affect (MA/LAA) determinations for 1,208 threatened and endangered species because of the potential for indirect effects alone. A review of the draft BE was undertaken to determine the basis for the EPA's concerns regarding indirect effects risks posed by thiamethoxam. Five case studies were undertaken to identify issues in the Agency's assessment for indirect effects. We then suggest improvements that should be implemented in the final BE for thiamethoxam.

The draft BE for thiamethoxam primarily relied on application of the Magnitude of Effect Tool (MAGtool). The MAGtool is intended to assist the EPA in efficiently evaluating the risks of potential pesticide use on listed species and designated critical habitats. The model is highly prescriptive and is essentially a compilation of generic, screening-level tools. However, there is a major drawback to reliance on an automated tool. For example, the Everglade snail kite (ESK) has an obligate dependency on apple snails for prey. As the MAGtool is currently implemented, the assessment of risks to ESK prey relied on an effects metric for sensitive aquatic insects. Aquatic insects are a highly sensitive receptor group not consumed by the ESK. In contrast, apple snails are highly tolerant to thiamethoxam exposure and to clothianidin exposure, a degradate of thiamethoxam. As the ESK and the other case studies demonstrate, the MAGtool does not consider critical species-specific foraging behaviors, diets and habitats, many of which are highly specialized. The model also does not consider proximity of where listed species and their prey and pollinators are found to areas where thiamethoxam may be used. Because many listed species occur in habitats that are not suitable for agriculture and development, proximity distances often exceed the distances that thiamethoxam can travel via off-field transport. This issue arose for many use patterns for which the EPA concluded MA/LAA for indirect effects.

The draft BE had other shortcomings including: using effects metrics for clothianidin instead of thiamethoxam even though clothianidin comprises a small fraction of applied thiamethoxam in aquatic and terrestrial environments; lack of consideration of highly relevant lines of evidence not incorporated in the MAGtool (e.g., monitoring data, higher tier mesocosom studies; and compounding conservatism at all steps in the exposure, effects and risk analyses. The compounding conservatism resulted in nearly every species not screened out prior to use of the MAGtool receiving a MA/LAA effect determination, primarily due to indirect effects to listed species. The case studies demonstrate that many listed species are, in fact, not likely to be adversely affected (MA/NLAA) by use of thiamethoxam. We recommend that the EPA consider a more realistic assessment approach in the final BE for thiamethoxam.

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1.0 INTRODUCTION

The US Environmental Protection Agency (EPA) released the draft Biological Evaluation (BE) for threatened and endangered species potentially exposed to thiamethoxam on August 26th, 2021 (EPA, 2021). Registration of pesticides under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) constitutes a Federal action under the Endangered Species Act (ESA). Under Section 7 of the ESA and the implementing regulations, if the Environmental Protection Agency (EPA or "the Agency") determines that its action "may affect" species, it must consult with the Fish and Wildlife Service and/or National Marine Fisheries Service ("the Services") to ensure that the pesticide's registration (the Federal action) is not likely to result in the destruction or adverse modification of designated critical habitat or jeopardize the continued existence of Federally threatened, endangered, and proposed species (hereafter, "listed species"). Although the EPA also reviews candidate species in their BEs, they do not have protections under the ESA. The EPA evaluates these species only in the context that they may be proposed for listing at a future date.

The purpose of the draft BE for thiamethoxam was to assess potential risks that registered uses of this pesticide may pose to listed species and designated critical habitats in the United States. Thus, registered uses and agreed upon changes to labels from technical registrants and approved product labels for pesticide products containing thiamethoxam were evaluated.

The assessment methods employed in the draft thiamethoxam BE followed the Revised Method for National Level Listed Species Biological Evaluations of Conventional Pesticides (referred to as the "Revised Method"; EPA, 2020a). The BE for thiamethoxam primarily relied on the application of the Magnitude of Effect Tool (MAGtool). The MAGtool is intended to assist EPA in efficiently evaluating the risks of potential pesticide use on listed species and designated critical habitats. The tool estimates the number of individuals of each listed species potentially impacted by a pesticide due to mortality losses or adverse sublethal effects. The tool also determines if there is the potential for adverse impacts on prey, pollinators, habitat, and/or biological dispersers (PPHD) upon which listed species depend. Effects on PPHD are often referred to as "indirect effects" to listed species.

Syngenta Crop Protection, LLC, retained Intrinsik Ltd. (Intrinsik) to review the draft BE for thiamethoxam. The focus of this review is on the potential for thiamethoxam to affect the PPHD upon which listed species depend. In the draft BE for thiamethoxam, the Agency assigned May Affect/Likely to Adversely Affect (MA/LAA) determinations for 1,396 out of 1,821 listed species (77% of listed species) that entered the Revised Method process. Of these, 1,208 were assigned MA/LAA determinations based on potential for indirect effects alone. The high number of MA/LAA determinations from indirect effects alone is unique for thiamethoxam compared to pesticides addressed in previous BEs using the Revised Method (i.e., carbamates, herbicides). It is thus important to review the basis for the EPA's concerns regarding indirect effects risks posed by thiamethoxam.

This review is organized into two major sections: General Comments and Case Studies. The general comments focus on the approach and methods used by the EPA to assess the potential for indirect effects to listed species. We then develop five case studies, each of which recaps the EPA's assessment and conclusions, identifies issues in the Agency's assessment, and suggests improvements that would justify changing the Agency's conclusion from Likely to Adversely Affect to Not Likely to Adversely Affect for the PPHD upon which each listed species depends. The draft BE for thiamethoxam and associated MAGtool files were downloaded on August 27th, 2021 from the EPA's draft BE and MAGtool websites.

2.0 GENERAL COMMENTS

The following comments are intended to identify and address scientific and technical concerns found in the EPA's assessment of effects of thiamethoxam to prey, pollinators, habitat and dispersers upon which listed species depend (i.e., indirect effects). Where possible, recommendations and information are provided that may fill data gaps, provide evidence to support or refute the EPA's assumptions, and address general deficiencies in the draft Biological Evaluation for thiamethoxam. Where possible, we use the case studies described in Section 3 of this report to illustrate our concerns and provide suggestions for improving the analyses in the draft BE.

2.1 Consideration of Habitats Required by Listed Species and the Proximity of Those Habitats to Thiamethoxam Use Patterns

As demonstrated in our case studies, many listed species have habitat requirements that are not conducive to growing crops or other uses for which thiamethoxam may be applied (e.g., field nurseries, soil amendments with poultry litter). As a result, the ranges of such species are not sufficiently proximal to thiamethoxam crop and other use pattern footprints to result in exposure. For example, the Alameda whipsnake (AWS) inhabits local variations of chaparral, which have low nutrient levels and range from deep, weakly developed soils to shallow, rocky soils (FWS, 2021a). Temperatures in AWS habitats often exceed 100°F. The salt marsh harvest mouse (SMHM) is endemic to the emergent wetlands of San Francisco Bay and its tributaries (Bias and Morrison, 1999) and is generally restricted to saline or brackish marsh habitats around the San Francisco Bay Estuary. The fragrant prickly-apple (FPA) is a cactus species only found in sand pine scrub habitat and in xeric hammock, coastal strand, and coastal hammocks along the Atlantic Coastal Ridge (FWS, 2021a). For each of these listed species, however, the EPA (2021) assumed that their dietary items (for the AWS and SMHM) or pollinators (for the FPA) were present on treated fields and other treated areas during thiamethoxam applications. Based on proximity analyses conducted for the agricultural use patterns deemed LAA by the EPA (2021) for these three listed species, none were found sufficiently close to result in adverse effects to dietary items. In fact, most were at distances beyond which the EPA assumes zero spray drift even for aerial applications of thiamethoxam. The EPA (2021) provided no scientific rationale in the draft BE for their assumption that dietary items or pollinators of listed species would be present on treated fields even though the habitat requirements of these receptor groups are generally similar to those where the listed species are found (e.g., the major dietary items of the SMHM are saltgrass and pickerel weed which also require brackish marsh habitats). Had the EPA (2021) accounted for proximity of thiamethoxam use patterns to the habitats where listed species are found and adjusted exposure accordingly using a spray drift model, many LAA conclusions for indirect effects would have been NLAA. This was our finding for the AWS, SMHM and FPA.

2.2 Consideration of Unique Diets of Listed Species

The MAGtool is an automated tool designed to improve the efficiency of the difficult task of assessing over 1800 listed species and over 800 critical habitats for a wide variety of use patterns, application methods and formulations. The model is highly prescriptive and is essentially a compilation of generic, screening-level tools. However, there is a major drawback to reliance on an automated tool, i.e., the model fails to consider critical species-specific foraging behaviors, diets and habitats, many of which are highly specialized. For example, the Alameda whipsnake has a near obligate dependency on western fence lizards for its diet (FWS, 2021a). The current implementation of the MAGtool, however, only considers terrestrial insects in estimating the effects of pesticides, including thiamethoxam, to the prey of the Alameda whipsnake. Terrestrial insects are infrequently consumed by this species and the EPA (2021) provided no evidence that reduced availability of insect prey would have any impact on even one individual Alameda whipsnake. The Alameda whipsnake case study (Section 3.3) provides additional details on this issue.

As with the Alameda whipsnake, the issue of focusing on an inconsequential dietary item played out for other terrestrial wildlife species, e.g., the salt marsh harvest mouse (see Section 3.4). In the case of the Everglade snail kite, the model correctly considered aquatic invertebrates as the major receptor group upon which the kite species depends for food. However, the Everglade snail kite has an obligate dependency on apple snails (Reichert et al., 2020), a unique dietary requirement that was not considered by the EPA (2021) in their draft BE (see Section 3.1). Although thiamethoxam is toxic to aquatic insects, it is non-toxic to aquatic snails including apple snails even at the upper bound concentrations estimated to occur by the EPA in habitats of the Everglade snail kite (see Figure 3-2).

The lack of species specificity regarding the dietary requirements of listed species led to the EPA (2021) concluding that use of thiamethoxam would adversely affect the availability of prey upon which listed species depend for numerous use patterns. Had the unique dietary requirements of listed animal species been considered, there likely would have been many fewer Likely to Adversely Affect conclusions. We recommend that the EPA modify the MAGtool to estimate exposure and risk to the major dietary items upon which each listed species depends, rather than focusing on worst-case or "easiest to model" minor dietary items. We further recommend that the EPA model typical diets for listed species that have multiple dietary items rather than modeling each dietary item assuming that it constitutes 100% of the diet.

2.3 Consideration of Other Relevant Lines of Evidence

The EPA documented in their draft BE the uncertainties associated with using the Pesticide Water Calculator (PWC) (which provides inputs to the MAGtool) to model static water bodies systems. The PWC assumes that such systems have no outlet, resulting in the accumulation of pesticide over time. Increases in water body volume that occur following runoff events are not included in the model. Thus, modeled EECs for thiamethoxam are over-predictions for static water bodies. For flowing water bodies, the PWC assumes a constant volume and flow, thus changes in pesticide concentrations arising from changes in flow rate are not modeled. Ideally, a watershed-based model (e.g., Surface Water Assessment Tool (SWAT)) should be applied to predict flowing water concentrations. These models can account for flow and volume fluctuations as well as predict concentrations within a watershed that has multiple source inputs. Watersheds (several orders of magnitude larger in size than the Index Reservoir), have substantial heterogeneity in runoff and transport processes, variability in pesticide usage (amounts, application practices, and application timing), and exhibit dampening and dispersion in chemograph peaks associated with variable travel times and attenuation. These factors are not accounted for in the Index Reservoir conceptual model that was applied in the thiamethoxam BE. Overall, both static and flowing water thiamethoxam EECs are uncertain and likely overestimated.

Although the Agency documented available monitoring data in the draft thiamethoxam BE, the data were not used to evaluate model performance, nor were the data used in making NLAA/LAA decisions for indirect effects to listed species. As demonstrated in our case studies for the Everglade snail kite and the sharpnose shiner (see Sections 3.1 and 3.2), the available monitoring data in the habitats and regions where the species are found were below the detection limit or orders of magnitude below the EPA's estimated environmental concentrations. Higher tier mesocosm studies are also available for thiamethoxam but were not considered as lines of evidence in the draft BE. The most relevant study by Finnegan et al. (2018) was an outdoor mesocosm study that included primary producers, zooplankton and macroinvertebrates (see Section 3.1.4 for details). The authors determined a No Observed Ecological Adverse Effect Concentration (NOEAEC) of 30 μg a.i./L. The NOEAEC is above the EPA's estimated 1-in-15 year concentrations for thiamethoxam in habitats of the Everglade snail kite and sharpnose shiner for all use patterns for which the EPA derived an Likely to Adversely Affect conclusion for indirect effects. This result occurred even though the mesocosm study included insect taxa known to be sensitive to thiamethoxam (e.g., Chironomidae, *Notonecta* sp.) (Finnegan et al., 2017, 2018). The NOEAEC is also orders of magnitude above the highest thiamethoxam concentrations detected in the regions and habitat types where the Everglade snail kite and sharpnose shiner are found.

The Pest Management Regulatory Agency (PMRA) in their Special Review of thiamethoxam (PMRA, 2021) used water monitoring data (along with its ancillary information) and a mesocosm-based effects metric in estimating risks to aquatic invertebrates. We recommend that the EPA incorporate other lines of evidence (i.e., monitoring data, mesocosm studies) in their decision making for listed species potentially exposed to thiamethoxam.

2.4 Use of Clothianidin Effects Metrics

The EPA (2021) identified both parent thiamethoxam and its degradant clothianidin as residues of concern for terrestrial and aquatic organisms in the draft thiamethoxam BE. To be conservative, the Agency used the most sensitive effects endpoint between clothianidin and thiamethoxam for each receptor group being assessed. Although clothianidin is more toxic to some terrestrial and aquatic receptor groups, the contribution of clothianidin from a thiamethoxam application for exposure to terrestrial and aquatic wildlife is relatively low (MRID 50425903, 50265504, 50265503, 49804105, 49804101, 50265502 for foliage studies; Harrington et al., 2018 for wetlands). This is particularly true at the time of application which is the basis for the nomograms used to estimate risk to terrestrial biota upon which listed species depend for prey, pollination services, and biological dispersal. Therefore, the EPA should have relied on thiamethoxam, not clothianidin, effects metrics for assessing indirect effects.

2.5 Conservativeness of PPHD Assessments

Compounding conservatism in the draft thiamethoxam BE is a significant concern and likely the most important reason for many of the Likely to Adversely Affect decisions for indirect effects to listed species. For example, the spatial data describing where the listed species ranges and critical habitats are located are imprecise and highly conservative (e.g., county level in most cases).

The assumption that state-level usage data occur within each species range (until all potential acres have been treated at the maximum permitted application rate and number of applications) is one of many unrealistic assumptions with regard to incorporating usage data to estimate exposure, particularly for listed species with small ranges. Although the EPA investigated more realistic assumptions regarding the spatial distribution of usage data for thiamethoxam, the more realistic analyses were only used in determining confidence in each LAA determination derived using the worst-case assumptions for usage data. Where no usage was reported, or where percent crop treated (PCT), in the summary use and usage matrix (SUUM) (Appendix 1-4, Table 2) was reported as "< 1%" or "< 2.5%", then the PCT was assumed to be 2.5% for that use pattern and state. This ultimately rolled up to the state-level PCTs for the associated UDL being set to 2.5% in the MAGtool inputs. Setting PCTs to be a minimum of 2.5% results in excessive overestimation of usage for some crops, particularly large acreage crops. The assumption of a minimum PCT of 2.5% is too high, as it results in unrealistic usage estimates that are not supported by best available datasets. A lower minimum of 1% or 0.5% would be more appropriate in cases where the available PCT indicates <1% or no usage, especially for larger acreage crops where seemingly small PCT values can lead to substantial amounts of thiamethoxam being assumed to enter the environment.

For terrestrial listed species, off-field drift estimates did not account for the habitats where listed species and the biota on which they depend for PPHD may be found. The EPA's spray drift model (i.e., AgDrift) provides upper bound estimates of drift based on data collected for drift over bare ground areas. Thus, spray drift interception, for example, vegetative filter strips, are not accounted for. Previously, the EPA considered spray drift interception and direction as a qualitative line of evidence supporting their conclusion that pinnipeds basking on beaches are not likely to be adversely affected by atrazine use (EPA, 2020b).

In the absence of data (e.g., toxicity tests for listed species) or in the presence of naturally variable data such as weather, risk assessments should be performed using reasonable and conservative assumptions that account for uncertainty. Compounding conservative assumptions at all steps in the exposure, effects and risk analyses, to give the 'benefit of doubt' to the listed species, leads to completely unrealistic risk estimates. Combining unrealistic exposure and risk estimates with a protection goal that is extremely conservative (e.g., one individual out of an estimated species population), results in nearly every species not screened out in Step 1 receiving a MA/LAA effect determination. This was indeed the case in the thiamethoxam BE, particularly for indirect effects to listed species. Although the Agency's effort to automate the BE process has led to improved efficiency, it has been at the expense of refinement and accuracy, leading to more species moving to Step 3 (i.e., Biological Opinions) than necessary. Consequently, individual species considerations that could have been included in the BE, will instead need to be addressed by the Services.

3.0 CASE STUDIES

The following five case studies are provided to assist the EPA with interpretation of available data and information that, with few exceptions, were not considered in the draft Biological Evaluation for thiamethoxam. The selected species are the Everglade snail kite (*Rostrhamus sociabilis plumbeus*), sharpnose shiner (*Notropis oxyrhynchus*), the Alameda whipsnake (*Masticophis lateralis euryxanthus*), the salt marsh harvest mouse (*Reithrodontomys raviventris*), and the fragrant prickly-apple (*Cereus eriophorus var. fragrans*). A discussion relevant to the draft May Affect, Likely to Adversely Affect (LAA) conclusion is provided for each of these species, but the key points and information also apply to many of the other listed species with LAA conclusions for indirect effects.

3.1 Everglade Snail Kite

Synopsis

- The Everglade snail kite (ESK) is a medium-sized raptor found in central and southern Florida that forages almost exclusively on apple snails found in shallow marshes that have clear open water.
- The EPA determined that there were no concerns for direct effects to the ESK for use patterns involving application of a flowable formulation.
- The EPA determined that 13 use patterns (e.g., poultry litter, open space developed, field nurseries, other grains, citrus, developed, vegetables and ground fruit) could reduce availability of aquatic invertebrate prey (i.e., apple snails). This projected effect resulted in the Likely to Adversely Affect (LAA) conclusion for the ESK.
- Toxicity data for three aquatic snail species indicate that snails are much less sensitive to thiamethoxam exposure than are aquatic insects. Had the EPA relied on the more relevant snail toxicity data instead of the HC05 from the species sensitivity distribution for aquatic insects, there would be no concern for effects to apple snails on which the ESK depends for prey.
- In the Status of Species (SOS) review included in the Biological Opinion for malathion, the FWS (2021a) did not identify insecticides as a threat to the ESK or its apple snail prey.
- The available information indicates that a "Not Likely to Adversely Affect" conclusion is appropriate for the ESK for all thiamethoxam use patterns within its range.

3.1.1 Status of Species Information

The ESK, *Rostrhamus sociabilis plumbeus*, is a wide-ranging raptor found in Florida, with other subspecies living throughout the Caribbean, Central America, and south to Argentina and Peru. The ESK was listed as endangered in the United States in 1967 and has maintained a small population since. It has a highly specialized diet almost exclusively comprised of apple snails (*Pomacea paludosa*), though the ESK has been observed feeding upon crayfish and one instance of speckled perch consumption (Cary, 1985; FWS, 1999; Reichert et al., 2020). The principal threats to the species are habitat loss, fragmentation, and degradation due to human agricultural and urban development. The most recent population estimate for the ESK was 1,754 birds in 2014 (Reichert et al., 2020), showing somewhat of a plateau after a period of sharp decline in the late 1990s and early 2000s (Martin et al., 2007). ESKs live primarily near freshwater marshes and at the edges of lakes usually with interspersed emergent vegetation and riparian trees such as willow and wax myrtle on the shoreline. They require clear and open areas to forage for apple snails, which are aquatic but climb emergent vegetation to breathe, feed, and lay eggs (Sykes, 1979; Beissinger, 1988). The range of the ESK is limited to central and southern Florida in six freshwater wetland ranges, mostly in the Upper St. Johns Marshes and the Everglades, but also in the Kissimmee Chain of Lakes, Lake Okeechobee, Loxahatchee Slough, and Big Cypress basin (Figure 3-1a) (Beissinger and Takekawa, 1983; Sykes, 1984; Rodgers et al., 1988; Bennetts and Kitchens, 1992; Rumbold and Mihalik, 1994; Sykes et al., 1995).

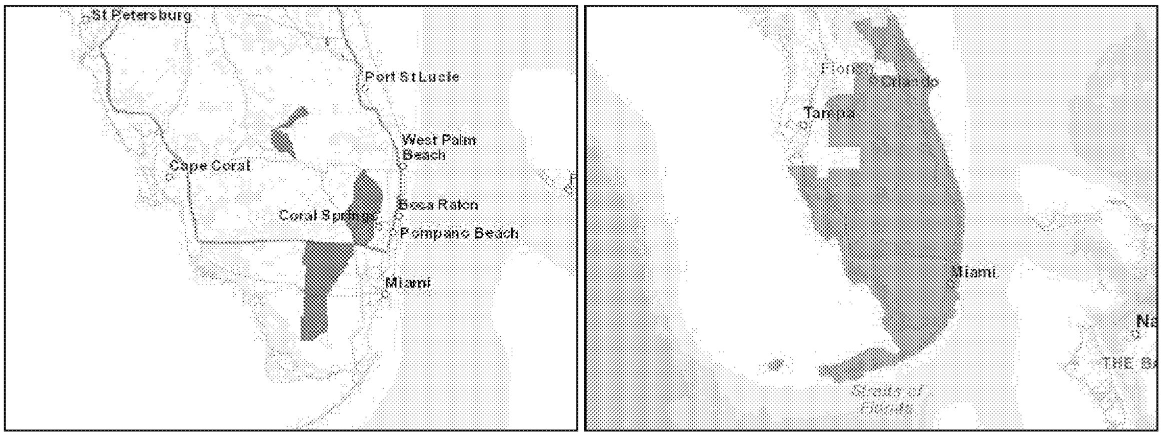

Figure 3-1 Everglade snail kite (a) species range (orange) and (b) critical habitat (red)

Nine areas of critical habitat were designated in 1977 (Figure 3-1b) and include the St Johns Reservoir, Cloud Lake reservoir, Strazzulla Reservoir, western Lake Okeechobee, Loxahatchee National Wildlife Refuge, three separate areas of the Central and Southern Florida Flood Control District Water Conservation Area, and a portion of Everglades National Park (FWS, 1999). Each of these areas contains suitable marshland with sufficient populations of apple snails to sustain breeding populations.

ESKs forage visually either by flying low above the water surface (course hunting) or from a perch (still hunting). Apple snails are captured by the kites' feet at up to 16 cm below the water surface; the kites never plunge or use their bills (Cary, 1985). They have never been observed drinking; therefore, it is likely that the high-water content of the snail is sufficient to meet their hydration needs (Reichert et al., 2020). Human activities such as hydrologic management have impacted their foraging habitat (FWS, 1999).

The only mention of agrochemicals as a potential threat to the ESK stems from use of herbicides to control aquatic weeds (FWS, 1999). Such herbicide use has probably improved foraging conditions for the snail kite in a few localized areas by removing dense growths and creating more open water for foraging. However, spraying could cause snail kite nests located in non-woody species (e.g., cattail, bulrush) to collapse. Local authorities have cooperated in efforts to reduce spraying near ESK nests (FWS, 1999).

3.1.2 Draft Biological Evaluation Summary

The draft LAA conclusion for the ESK is entirely due to predicted effects of thiamethoxam on its prey, which is nearly exclusively comprised of apple snails (Cary, 1985; FWS, 1999; Reichert et al., 2020). The MAGtool exposure estimates by use pattern from Appendix 4-9 (EPA, 2021) are summarized in Table 3-1. The exposure estimates are the maximum concentrations estimated for Bin 7 (high-volume static water body, >20,000 m^3) in HUC 3 which is the region where the ESK is found. These exposure estimates are highly conservative given that they are maximum values and for static water bodies the size of the EPA's standard pond. The ESK habitat generally comprises much larger freshwater systems (e.g., several lakes) (FWS, 1999).

Table 3-1 Estimated 1-in-15 year concentrations of thiamethoxam in Bin 7 habitats in HUC 3. All data are from the draft BE (EPA, 2021).

Use Pattern	*1-in-15 Year Concentration (µg a.i./L)*
CONUS_Poultry Litter	3.78
CONUS_Open Space Developed	5.90
CONUS_Field Nurseries	14.2
CONUS_Other Grains	6.47
CONUS_Citrus	8.05
CONUS_Developed	14.2
CONUS_Vegetables and Ground Fruit	8.59
CONUS_Other Crops	11.7
CONUS_Other Orchards	11.0
CONUS_Other Row Crops	6.01
CONUS_Grapes	7.99
CONUS_Soybeans	4.34
CONUS_Cotton	4.48
Maximum Estimated Environmental Concentration	**14.2**

The effects metric used to estimate risk to prey of the ESK is the acute HC05 of 3.58 μg a.i./L derived for clothianidin by the EPA using toxicity data for aquatic insects only, a receptor group that has high sensitivity to neonicotinoids including thiamethoxam (Prosser et al., 2016; Finnegan et al., 2017; EPA, 2021).

The draft thiamethoxam BE for the ESK does not account for the availability of toxicity data for aquatic snails, nor does it account for a higher tier mesocosm study involving aquatic invertebrates. Further, the basis for relying on a clothianidin effects metric for aquatic invertebrates has not been adequately supported by the EPA (2021) in the draft BE for thiamethoxam.

The Endangered Species Act compels the EPA to use the "best available data" to assess risk to listed species. Therefore, the data discussed below constitute the highest quality and most relevant available data to determine whether thiamethoxam is likely or not likely to adversely affect the ESK via effects to its prey, apple snails, for which the ESK has an obligate dependency.

3.1.3 Single Species Toxicity Data for Aquatic Invertebrates

In chapter 3 of the draft BE, the EPA (2021) stated that "… in the aquatic exposure analysis, thiamethoxam represents the majority of the residue." This is likely due to the lack of degradation of thiamethoxam to clothianidin in water although some clothianidin (approximately 20-30% of applied thiamethoxam) can potentially reach aquatic systems from degradation in terrestrial systems and subsequent runoff (see Section 2.4). Thus, there is no reason for the EPA (2021) to have used a clothianidin effects metric instead of a thiamethoxam effects metric in assessing effects of thiamethoxam to freshwater invertebrate prey.

The available toxicity data indicate a wide range of sensitivity for aquatic invertebrates to thiamethoxam with acute EC/LC50s spanning over four orders of magnitude ranging from 5.5 μg a.i/L for the mayfly (*Neocloeon triangulifer*) to >100,000 μg a.i./L for several non-insect species (Figure 3-2). Because the ESK is nearly completely dependent on apple snails for prey, it is critical to consider the availability of snail toxicity data in the ESK indirect effects assessment. Three species of aquatic snails have been tested for sensitivity to thiamethoxam. The three snail species are highly tolerant to thiamethoxam exposure with EC/LC50s ranging from 6,195 μg a.i./L (Prosser et al., 2016) for the ramshorn snail (*Planorbella pilsbryi*) to >100,000 μg a.i./L for the great pond snail (*Lymnaea stagnalis*) and the wandering pond snail (*Radix peregra*) (Finnegan et al., 2017). Given the available toxicity test data for aquatic snails (i.e., three tested species) and the consistent highly tolerant response across the tested snail species (see Figure 3-2), the EPA should have used the available snail toxicity test data, likely the most sensitive tested snail species, in assessing the potential for thiamethoxam to affect prey of the ESK.

Additional details of the two acute toxicity studies involving freshwater snails exposed to thiamethoxam are provided below.

Prosser et al. (2016) evaluated the toxicity of thiamethoxam (95-98% purity) to the ramshorn snail (*Planorbella pilsbryi*). Juvenile snails between four and six weeks of age were exposed to thiamethoxam in water for seven or 28 days. Nominal exposure concentrations were 10, 50, 100, 500, 1000, 5,000, and 10,000 a.i. μg/L. The two highest test concentrations were only used for the 7-day exposure portion of the study. Measured concentrations were 0.7 to 5.3% lower than nominal and are thus considered acceptable. Juvenile snails were examined, and solutions replaced, weekly. The 7-day LC50 was 6,195 μg a.i./L.

Finnegan et al. (2017) conducted 29 acute toxicity tests involving freshwater aquatic invertebrates for 21 species including insect, worm and snail species. All acute tests followed GLP and were 24- or 48-h, water-only, static tests, with endpoints of immobilization and/or mortality. In all acute tests with aquatic invertebrates, <10% response (immobility/mortality) was observed in control treatments. Measured concentrations were typically 80 to 120% of nominal. As expected, aquatic insects were the most sensitive species tested, except for the phantom midge larvae *Chaoborus* sp. Most non-insect species were not sensitive to thiamethoxam, including the two snail test species which had a 48-hour EC50 that was >100,000 μg a.i./L.

According to the EPA's draft BE, 1-in-15 year daily thiamethoxam concentrations in habitats favored by the ESK and their apple snail prey (i.e., Bin 7 in HUC 3) are predicted to range up to 14.2 μg a.i./L for the field nurseries and the developed use patterns (Table 3-1). This upper bound value is 429-fold below the EC/LC50 of the most sensitive aquatic snail species. For obligate dependencies involving aquatic invertebrate prey, as is the case with the ESK and its apple snail prey, the guidance in the Revised Method is to use the lowest available EC50 or LC50 when there are insufficient data to derive an SSD (EPA, 2020a). Thus, given the safety margin between the upper bound predicted concentration in ESK habitats and the most sensitive acute LC50, thiamethoxam does not pose a risk to the only prey species of importance to the Everglade snail kite. In addition, given that the studies conducted by Prosser et al. (2016) and Finnegan et al. (2017) involved static without renewal exposures in the acute studies, any conversion of thiamethoxam to clothianidin would be accounted for in the test results. Thus, there is no need to consider clothianidin toxicity to aquatic snails. That said, tested aquatic snail species are completely tolerant to clothianidin exposure, e.g., no toxicity occurred at the highest test concentration 327,000 μg a.i./L for the marsh ramshorn snail (*Helisoma trivolvis*) and the acute bladder snail (*Physella acuta*) (Miles et al., 2017).

Relative to available monitoring data, the estimated concentrations in Bin 7 in HUC 3 are almost substantially overestimated, likely by orders of magnitude. Monitoring data obtained from the National Water Quality Monitoring Council's Water Quality Data Portal by the EPA (see Table 3-11 in the draft BE) indicate that of the 1604 samples taken from 499 sites in HUC 3 from 2011 to 2021, 1426 had thiamethoxam concentrations below the detection limit. The concentrations in the remaining samples ranged from 0.0082 to 2.7 μg a.i./L. Published monitoring studies generally found concentrations in the same range as found in the Water Quality Data Portal (see Section 3.8.2 in the draft BE).

There are several major reasons why the thiamethoxam concentrations modeled by the EPA are overestimated, particularly for non-agricultural uses such as open space developed, developed, and field nurseries. The footprints for several non-agricultural use patterns (e.g., poultry litter, with subsequent spreading of treated litter on crop fields, developed, and open space developed) are broad and the EPA assumed that 100% percent of available acres were treated within these footprints (=100% Percent Crop Treated). However, the available thiamethoxam usage data indicates very low use annually for non-agricultural use patterns (see Table 3 in Appendix 1-4 of the draft BE) and some of the use is indoors or directed to cracks and crevices which would have very limited, if any, associated spray drift or runoff to ESK habitats. There are many other sources of conservatism in the EPA's water quality modeling as described by Moore et al. (2021). Thus, the margin of safety for apple snail prey is far greater than the nearly 429-fold safety margin estimated above when using the worst-case exposure concentration and the most sensitive EC/LC50 for aquatic snails.

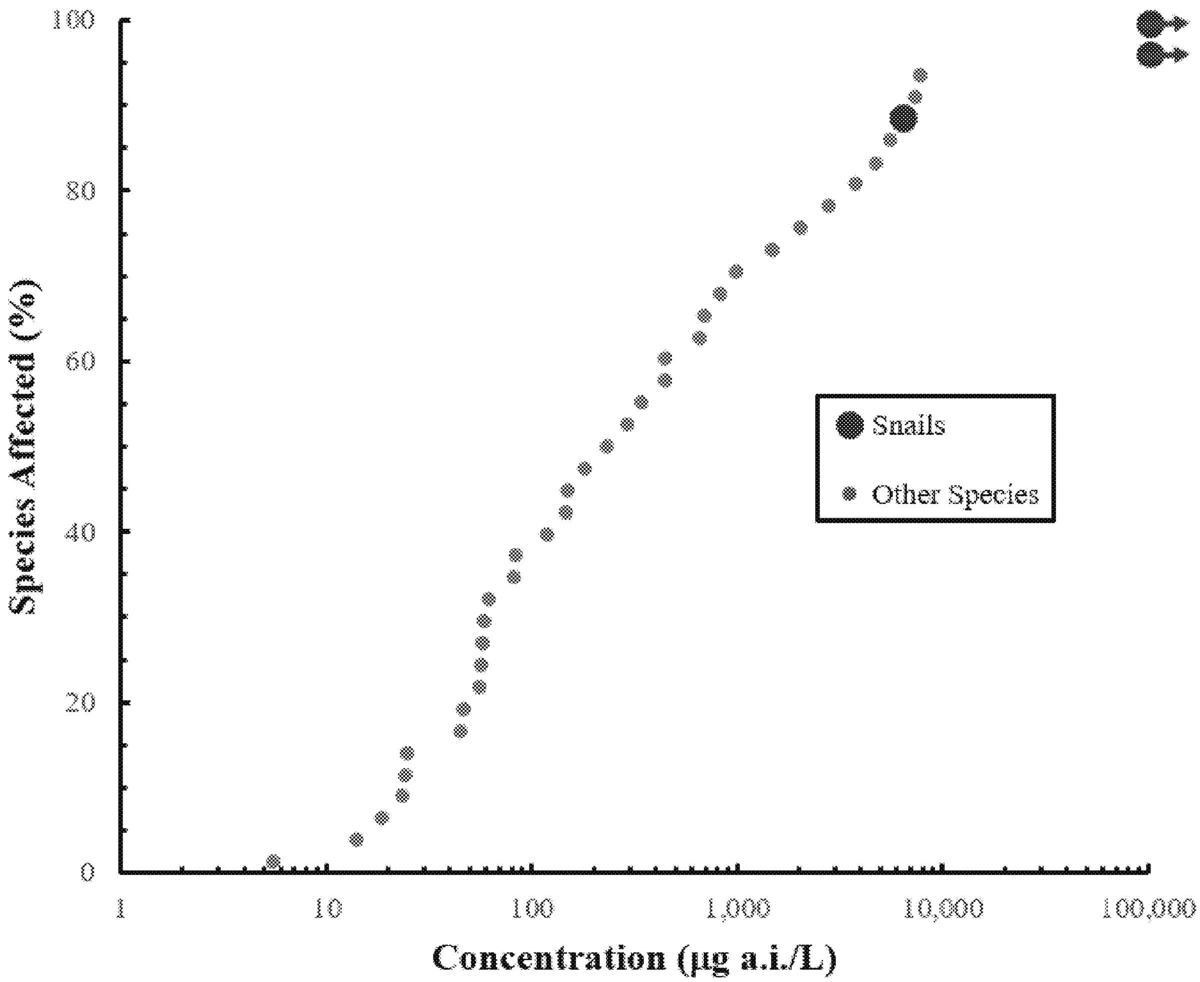

Figure 3-2 Acute species sensitivity distribution for aquatic invertebrate species exposed to thiamethoxam. Data from the PMRA (2021) and Miles et al. (2017). Arrows indicate unbounded EC/LC50s.

3.1.4 Mesocosm Study

Higher tier assessments such as is the case with a Step 2 Biological Evaluations for pesticides should incorporate more refined tools (e.g., population models, probabilistic analyses) and other lines of evidence (e.g., mesocosm and field studies) to ensure a more robust and realistic characterization of risk. The draft Biological Evaluation for thiamethoxam did not consider available mesocosm studies for aquatic communities in assessing the risks of thiamethoxam use to aquatic prey (i.e., apple snails) of the ESK. We review the most relevant study below.

An outdoor mesocosm study was conducted by Finnegan et al. (2018) to determine the effects of thiamethoxam on aquatic communities that included primary producers, zooplankton and macroinvertebrates. Mesocosms (1300 L) were treated once with a formulated thiamethoxam product at nominal concentrations of 1, 3, 10, 30, and 100 µg a.i./L, plus untreated controls. The mesocosms were monitored for up to 93 days following treatment. Thiamethoxam had a water column dissipation half-life (DT50) ranging from <1.6 to 5.2 days. Community-based principal response curve analysis detected no treatment effects for phytoplankton, zooplankton, emergent insects, and macroinvertebrates. Several statistically significant differences from controls were detected for abundances of individual phytoplankton and zooplankton species abundances. These single species effects were not treatment-related due to their transient nature and lack of a concentration-response relationship. In the 30 µg a.i/L treatment, slight temporary effects on *Asellus aquaticus* could not be excluded. In the 100 µg a.i./L treatment, there was an effect with no clear recovery of *Asellus* observed, likely due to their inability to recolonize the test systems. A statistically significant but transient reduction in the emergence of chironomids by day 23 in the 100 µg a.i./L treatment was observed possibly due to direct toxicity on larval stages. No effects were found for the macroinvertebrates, *Crangonyx pseudogracilis*, Zygoptera, and Chaoboridae, as well as for different snail species. The authors conservatively concluded that the No Observed Ecological Adverse Effect Concentration (NOEAEC) in the mesocosm study was 30 µg a.i./L. The NOEAEC is well above the EPA's estimated 1-in-15 year concentrations for thiamethoxam in Bin 7 habitats (Table 3-1) even though the mesocosm study included insect taxa known to be sensitive to thiamethoxam (e.g., Chironomidae, *Notonecta* sp.) (Finnegan et al., 2018). Snails were not affected at the highest test concentration of 100 µg a.i./L.

Mayflies and other sensitive insects are not part of the diet of the ESK. Therefore, even a significant reduction in availability of aquatic insects in the ESK range would have a negligible effect on this species. The mesocosm study clearly demonstrates that the availability of aquatic invertebrate prey, including snails, are unaffected by thiamethoxam at concentrations well above environmentally-relevant concentrations.

3.1.5 Conclusions

The future of the ESK is highly vulnerable primarily because of loss of habitat. The evidence provided herein indicates that use of thiamethoxam will have a negligible effect on the availability of the apple snail prey upon which the ESK depends. The EPA (2021) found no concern for direct effects of thiamethoxam to Everglade snail kites.

3.2 Sharpnose Shiner

Synopsis

- The Sharpnose shiner (SNS) is a cyprinid minnow found in the Brazos River drainage area, Texas.
- The SNS is a generalist forager of aquatic and, when available, terrestrial invertebrates.
- The EPA (2021) determined that there were indirect adverse effects to the SNS from 11 use patterns including poultry litter, cotton, other grains, open space developed,

developed, and vegetables and ground fruit for the flowable formulation of thiamethoxam.

- No direct effects of thiamethoxam to the SNS were predicted for any use pattern. The basis for the Likely to Adversely Affect (LAA) conclusion for this species was due to predicted effects to freshwater invertebrate prey.
- Toxicity data as presented in the acute species sensitivity distribution for aquatic invertebrates indicate that freshwater invertebrates have a wide tolerance range to thiamethoxam. Thiamethoxam concentrations in SNS habitats are unlikely to affect the invertebrate community upon which it depends for food.
- The most relevant available mesocosm study demonstrates that thiamethoxam is unlikely to cause community-level invertebrate effects that would lead to reduced prey availability.
- In the Status of Species (SOS) review, the FWS did not identify pesticides as a threat to the SNS.
- The available information indicates that a "Not Likely to Adversely Affect" conclusion is appropriate for the SNS for thiamethoxam use patterns within its range.

3.2.1 Status of Species Information

The SNS (*Notropis oxyrhynchus*) is a small (30 to 50 mm) minnow in the Cyprinidae family. Historically, the SNS has occurred throughout the Brazos River system in Texas, including the Double Mountain and Salt Forks of the Upper Brazos River drainage. It is now limited to the contiguous river segments of the upper Brazos River basin in north-central Texas (Hydrologic unit code (HUC) 12) (FWS, 2018). The SNS has designated critical habitat under the ESA that includes areas in Baylor, Crosby, Fisher, Garza, Haskell, Kent, King, Knox, Stonewall, Throckmorton, and Young counties, Texas. Some of the key physical and biological features of this critical habitat include unobstructed, sandy-bottom river segments greater than 275 km in length; flowing water of greater than 2.61 m^3/sec (i.e., Bins 3 and 4); water quality to support survival and reproduction (e.g., temperature<39.2 °C; dissolved oxygen>2.66 mg/L); and native riparian vegetation capable of maintaining river quality and the riparian ecosystem (FWS, 2018). Length of river segment is an important feature as the SNS broadcast spawns semi-buoyant eggs that remain ichthyoplanktonic (floating in the water column) for up to five days before larval fish are capable of independent swimming. Therefore, a long length of river/stream that can support their successful recruitment is required (FWS, 2018).

The diet of the adult SNS includes aquatic invertebrates in the Dipteran, Ostracod, Trichopteran, Odonatan, Coleopteran, and Hemipteran orders as well as terrestrial invertebrates taken opportunistically (FWS, 2018). SNS are therefore generalist feeders.

Threats to the SNS include modification and fragmentation of river habitat due to the construction of reservoirs, impoundments, and other human activities such as mining, industrial, and municipal discharges, cattle feedlot operations, and desalinization. Sedimentation and saltcedar growth are also threats to the species. Water quality degradation from point and non-point source pollution and commercial bait harvesting are threats to the SNS. Pesticides are not listed as a threat by the Fish and Wildlife Service (FWS, 2018, 2020).

3.2.2 Draft Biological Evaluation Summary

The draft LAA conclusion for the SNS is entirely due to predicted effects of thiamethoxam to its aquatic invertebrate prey (EPA, 2021). The MAGtool exposure estimates by use pattern from Appendix 4-9 (EPA, 2021) are summarized in Table 3-2. The exposure estimates are the 1-in-15 year concentrations estimated for Bin 3 (moderate flow water body, 1 to 100 m^3/sec) in HUC 11b, 12a and 12b, the watersheds where the SNS is found.

Table 3-2 Estimated 1-in-15 year concentrations of thiamethoxam in Bin 3 habitats in HUC 11a, 12a and 12b. All data are from the draft BE (EPA, 2021).

Use Pattern	*1-in-15 Year Concentration (µg a.i./L)*
CONUS_Poultry Litter	17.9
CONUS_Cotton	7.61
CONUS_Other Grains	8.15
CONUS_Other Crops	22.1
CONUS_Open Space Developed	5.02
CONUS_Developed	10.1
CONUS_Vegetables and ground fruit	11.2
CONUS_Other Row Crops	6.39
CONUS_Field Nurseries	10.1
CONUS_Other Orchards	10.1
CONUS_Soybeans	8.72
Maximum Estimated Environmental Concentration	**22.1**

The effects metric used to estimate risk to prey of the SNS is the most sensitive LOAEC of 0.05 µg a.i./L from a chronic toxicity study by Cavallaro et al. (2016) on effects of clothianidin to chironomid emergence. The EPA (2021) presumably chose a clothianidin endpoint because it is more toxic than thiamethoxam to freshwater invertebrates in chronic studies (see Table 2-13 in EPA, 2021).

The draft Thiamethoxam BE for the SNS relied on a chronic LOAEL for clothianidin despite using an acute HC05 for clothianidin for the Everglade snail kite. The SNS and ESK both rely on aquatic invertebrates for prey. The draft BE for the SNS also did not account for a higher tier mesocosm study involving aquatic invertebrates exposed to thiamethoxam.

The Endangered Species Act compels the EPA to use the "best available data" to assess risk to listed species. The LAA conclusion for the SNS is the result of several unreasonable assumptions and does not account for readily available refined data and information. We discuss this information below for inclusion in the final BE for the SNS and for other similar listed species for which the same issues apply (e.g., smalleye shiner). The data discussed below constitute the highest quality and most relevant data to determine whether thiamethoxam is likely or not likely to adversely affect the SNS via effects to its prey, freshwater aquatic invertebrates, for which the SNS has a generalist dependency.

3.2.3 Single Species Toxicity Data for Aquatic Invertebrates

The available toxicity data for thiamethoxam indicate a wide range of sensitivity for aquatic invertebrates with acute EC/LC50s spanning over four orders of magnitude ranging from 5.5 µg a.i/L for the mayfly (*Neocloeon triangulifer*) to >100,000 µg a.i./L for several non-insect species (Figure 3-2). In their assessment of effects to SNS prey, however, the EPA (2021) did not rely on their acute HC05 for aquatic insects. Instead, the Agency relied on the most sensitive LOAEC of 0.05 µg a.i./L from a chronic toxicity study by Cavallaro et al. (2016) on effects of clothianidin to chironomid emergence. The effects metric used by the EPA (2021) for SNS prey is questionable:

- The SNS prey effects metric is inconsistent with the ESK prey effects metric, even though both species rely on freshwater invertebrate prey in their diets. No information was provided by the EPA (2021) to explain this inconsistency. The inconsistent choice of effects metric is a critical point as the clothianidin LOAEC of 0.05 µg a.i./L is 72-fold lower than the HC05 of 3.58 µg a.i./L. The difference is even larger with the thiamethoxam HC05 of 11.87 µg a.i./L, i.e., a 237-fold difference.
- SNS are generalist feeders that do not have an obligate dependency on a particular prey species such as the highly sensitive chironomid species that is the basis for the chronic LOAEC. Effects to a few sensitive prey species are unlikely to affect overall prey availability in the invertebrate community, as was demonstrated in the mesocosm study by Finnegan et al. (2018).
- The Cavallaro et al. (2016) chronic LOAEC for the chironomid, *Chironomus dilutus*, exposed to clothianidin could not be replicated in a study repeated in the same laboratory (Maloney et al., 2018) or in an independent study (Raby et al., 2018). It has also not been supported by a higher tier study conducted for clothianidin wherein a community-level NOAEC of 0.281 µg a.i./L was derived (Hartgers and Roessink, 2015). Therefore, the Cavallaro et al. (2016) study should not have been used in the draft BE for thiamethoxam (or in the clothianidin BE) because of serious concerns regarding study repeatability.

- As discussed in Section 2.4, clothianidin concentrations arising from thiamethoxam applications are much lower than the corresponding concentrations of the parent compound. Therefore, the EPA (2021) should not have used a clothianidin effects metric instead of a thiamethoxam effects metric in assessing effects of thiamethoxam to freshwater invertebrate prey.
- The SNS requires at least moderate flow rivers (FWS, 2018). Thus, any thiamethoxam reaching their habitat via spray drift or runoff would be rapidly diluted and exposure pulses would be short-lived. Data from a wetland monitoring study in Canada found that the DT50 ranged from 2.5 to 22.2 days with an average of 11.6 days (MRID 51485101). Thiamethoxam was shown to have a dissipation half-life of 11.6 to 17.2 days in the water column in paddy studies conducted in Arkansas and Louisiana. Paddy systems are static systems not subject to dilution and removal by downstream transport. Thus, the EPA (2021) should have used an acute effects metric for assessing effects of thiamethoxam to freshwater invertebrate prey of the SNS, as was done in the ESK assessment. Further, the aquatic EECs shown in Table 3-2 that were used in the SNS assessment are 1-in-15 year concentrations (i.e., the 2nd highest annual maximum daily concentration over the 30-year simulation) and are thus indicators of worst-case acute exposure. It is inappropriate to compare acute EECs to the chronic LOAEC from Cavallaro et al. (2016) where the endpoint was reduced chironomid emergence after 42 days of exposure.
- In the Revised Method guidance, the EPA (2020a) states on page 16 … "When considering indirect effects for listed species that rely on animals (e.g., as prey or pollinators), effects will be focused on <u>mortality</u> endpoints for the taxa relied upon. For generalists, the endpoints will be based on <u>the LD50/LC50 that corresponds to the lower fifth percentile of an SSD (if available) or the most sensitive LD50/LC50 value available</u> for the animal taxa relied upon (using the most sensitive taxon)." Thus, according to the Agency's own guidance, the EPA should not be using chronic endpoints to assess risks of effects to aquatic invertebrate prey of listed species.

Most of the prey of the SNS are aquatic insects (FWS, 2018). Given the above points and the diet of the SNS, the EPA (2021) should have relied on the acute SSD for aquatic insects derived for thiamethoxam. The HC05 from thiamethoxam acute SSD is 11.87 µg a.i./L. That change alone would eliminate all but two (i.e., other crops, poultry litter) of the 11 use patterns deemed by the EPA (2021) as posing a risk to the freshwater invertebrate prey of the SNS (see Table 3-2). A recent review by Priest and Moore (2021) found that the HC05 is overly protective of effects at the community level of organization, even for sensitive receptor groups. Adverse effects of pesticides at the community level of organization in mesocosm and field studies published in the literature tended to begin at approximately the HC20 or higher. As a result, Priest and Moore (2021) recommended that the HC20 be used for assessing effects to receptor groups on which listed species have a generalist dependency, as is the case for the SNS. Previous laboratory SSD validation studies have shown that HC20s are protective of natural ecosystems based on mesocosm results (Del Signore et al., 2016). Other investigators have compared the results of SSDs with multispecies and field tests and found that the HC05s were lower than the ecosystem NOECs (Emans et al., 1993; Okkerman et al., 1993; Versteeg et al., 1999; van den Brink et al., 2002). Previous comparisons indicated that HC05s were 1.4 to 75 times lower than corresponding NOECs measured in field studies (Del Signore 2015; Maltby et al. 2009). Grist et al. (2006) derived an SSD from chlorpyrifos toxicity data for fish and aquatic invertebrates. The SSD included 17 LC50 (median lethal concentration) values ranging from 0.07 to 540 µg a.i./L. The HC05 was 0.0253 µg a.i./L. Adverse effects measured in mesocosms were observed at >0.2 µg a.i./L, an order of magnitude higher than the HC05, and recovery was evident within 2 to 8 weeks (Grist et al., 2006). Mebane (2010) derived a chronic SSD for aquatic species exposed to water hardness-normalized cadmium. The SSD was then compared to the results of biological surveys of aquatic communities in the Coeur d'Alene region in Idaho as well as the results of a whole lake ecosystem experiment. Mebane (2020) observed little to no effects in the ecosystem experiment or biological surveys when observed concentrations were at or below the HC05. Losses of diversity of stream fishes and invertebrates occurred when water hardness-normalized cadmium concentrations were in the chronic HC20 to HC50 range. The EPA (2021) did not specify the thiamethoxam HC20 for aquatic insects, nor was the fitted equation provided to enable determination of the HC20. However, examination of Figure 1 in Appendix 2-5 of the draft BE indicates that the HC20 is approximately 40 µg a.i./L, which is well above the 1-in-15 year concentrations of thiamethoxam for all use patterns occurring in areas where the SNS is found.

The thiamethoxam concentrations modeled by the EPA are overestimated, particularly for non-agricultural uses such as poultry litter, open space developed, and developed. The footprints for several non-agricultural use patterns (e.g., poultry litter, with subsequent spreading of treated litter on crop fields, developed, and open space developed) are broad and the EPA assumed 100% percent treated within these footprints. However, the available usage data indicates very low use annually for non-agricultural use patterns (see Table 3 in Appendix 1-4 of the draft BE) and some of the use is indoors or directed to cracks and crevices which would have very limited, if any, associated spray drift or runoff to SNS habitats. There are many other sources of conservatism in the EPA's water quality modeling as described by Moore et al. (2021). Thus, the margin of safety for aquatic invertebrate prey of the SNS is much larger than appears by direct comparison of the acute HC20 to the 1-in-15 year concentrations in Table 3-2. The available monitoring data further support this point. Monitoring data obtained from the National Water Quality Monitoring Council's Water Quality Data Portal by the EPA (see Table 3-11 in the draft BE) indicate that of the 186 samples taken from seven sites in HUC 11 from 2012 to 2019, not one had a thiamethoxam concentration above the detection limit. This was also the case for the only sample collected in HUC 12 in 2012.

3.2.4 Mesocosm Study

The EPA (2021) did not consider the outdoor mesocosm study conducted by Finnegan et al. (2018) to determine the effects of thiamethoxam on aquatic communities that included primary producers, zooplankton and macroinvertebrates. The authors conservatively concluded that the No Observed Ecological Adverse Effect Concentration (NOEAEC) in the mesocosm study was 30 µg a.i./L (for details, see Section 3.1.4). The NOEAEC is well above the EPA's estimated 1-in-15 year concentrations for thiamethoxam in Bin 3 habitats (Table 3-2) even though the mesocosm study included insect taxa known to be sensitive to thiamethoxam (e.g., Chironomidae, *Notonecta* sp.) (Finnegan et al., 2018).

The mesocosm study clearly demonstrates that the availability of aquatic invertebrate prey is unaffected by thiamethoxam at concentrations well above environmentally-relevant concentrations.

3.2.5 Conclusions

Modification and fragmentation of river habitat due to the construction of reservoirs, impoundments, and other human activities are the major threats to the SNS. Pesticides are not listed as a threat by the Fish and Wildlife Service (FWS, 2018, 2020). The evidence provided herein indicates that use of thiamethoxam will have a negligible effect on the availability of the freshwater invertebrate prey upon which the SNS depends. The EPA (2021) found no concern for direct effects of thiamethoxam to the SNS.

3.3 Alameda Whipsnake

Synopsis

- The Alameda whipsnake (AWS) is a threatened species of colubrid snake found in California's northern and coastal chaparral.
- The primary prey item of the AWS is the western fence lizard though the listed species also preys on other herptiles, small birds and mammals, and terrestrial insects.
- The EPA (2021) determined that there were indirect adverse effects to the AWS from 12 use patterns including poultry litter, open space developed, developed, grapes, other grains, other crops, and vegetables and ground fruit for the flowable formulation of thiamethoxam.
- No direct effects of thiamethoxam to the AWS were predicted for any use pattern. The basis for the Likely to Adversely Affect (LAA) conclusion for this species was due to predicted effects to terrestrial invertebrate prey that occur in treated areas.

- The chaparral habitat of the AWS is not found near agricultural crops. When proximity to potential treated areas is considered, there are no risk concerns for terrestrial invertebrate prey of the AWS.
- Further, the primary prey item of the AWS is the western fence lizard, not terrestrial invertebrates. The EPA did not assess potential risks to the western fence lizard or other vertebrate prey. Given the lack of predicted effects to the AWS, a herptile species, it is unlikely that its herptile prey are at risk.
- In the Status of Species (SOS) review, the FWS did not identify pesticides as a threat to the AWS.
- The available information indicates that a "Not Likely to Adversely Affect" conclusion is appropriate for the Alameda whipsnake for thiamethoxam use patterns within its range.

3.3.1 Status of Species Information

The AWS (*Masticophis lateralis euryxanthus*) was designated as a threatened species on December 5, 1997 (FWS, 2005). Historically, the species was limited to the coastal scrub and oak woodland communities of the East Bay in Contra Costa, Alameda, and parts of San Joaquin and Santa Clara Counties in California (FWS, 2005). Its current range remains relatively similar but has been fragmented into five populations with little or no interchange due to habitat loss, alteration, and fragmentation. The areas include Tilden-Briones, Oakland-Las Trampas, Hayward-Pleasanton Ridge, Sunol-Cedar Mountain, and the Mount Diablo-Black Hills (FWS, 1997, 2005).

The AWS inhabits local variations of chaparral, such as coastal sage scrub and northern coastal scrub. It can be found in chaparral foothills, shrublands with scattered grassy patches, rocky canyons and watercourses, and adjacent habitats. When inactive, the snakes seek shelter underground or under cover (Westphal, 1998; FWS, 2011). Telemetry data indicate that AWS in scrub communities periodically venture into adjacent habitats for distances of greater than 500 feet, including grassland, oak savanna, and oak-bay woodland (FWS, 2011). Grassland habitats are used by male whipsnakes most extensively during the mating season in spring. Female whipsnakes use grassland areas after mating, possibly for suitable egg-laying sites (FWS, 2011). Whipsnakes require small mammal burrows for temperature regulation, egg-laying sites, refuge from predators, and winter hibernaculum (FWS, 2005).

The AWS avoids close woodland canopies with tall, dense vegetation that create a cool environment (FWS, 2011; EPA, 2010). Rock outcrops and talus are characteristic of whipsnake habitat. They both provide cover for whipsnakes and promote populations of their primary prey (FWS, 2005, 2021a). AWS are active daytime predators and foragers. The snakes hold their heads high to look over grass or rocks for prey. Western fence lizards (*Sceloporus occidentalis*) are their primary prey, and FWS (2021a) notes that AWS are a feeding specialist on the species. In addition to western fence lizards, AWS feed on a variety of secondary prey including frogs (*Pseudacris* sp. and *Lithobates* sp.), skinks (Scincidae), alligator lizards (*Elgaria* sp.), snakes, small birds, amphibians, single-slender salamanders (*Batrachoseps attenuatus*), small mammals, fish, and insects (FWS, 2011, 2021a).

The main threat to the AWS is habitat loss resulting from urban expansion (FWS, 2006). Fragmentation of whipsnake populations due to road and highway development has made the snake particularly vulnerable to extinction (FWS, 1997). Urban development in areas surrounding AWS habitat has increased predation by feral cats and the likelihood of injury and death from public recreational uses. Other major threats include improper management of cattle grazing practices, fire suppression, and related wildfire problems associated with lack of fuel reduction (FWS, 1997, 2021a). Fire suppression reduces the diversity of microhabitats available to AWS (Swaim, 1994). Overgrown chaparral creates habitats that are too cool for AWS to maintain proper body temperatures (Westphal, 1998). Pesticide use has not been cited as a threat to the AWS nor is there any indication that the species forages in or near agricultural habitats.

3.3.2 Draft Biological Evaluation Summary

The draft LAA conclusion for the AWS is entirely due to predicted effects of thiamethoxam to terrestrial insect prey (EPA, 2021). The MAGtool exposure estimates for use patterns at potential risk are summarized in Table 3-3. The exposure estimates are mean estimated environmental concentrations in arthropods from the nomogram included in the T-REX model. The highest value of 17.3 mg a.i./kg ww was derived for six use patterns (i.e., poultry litter, open space developed, developed, other crops, field nurseries, other orchards) (Table 3-3). This value is associated with the maximum label application rate for the flowable formulation of thiamethoxam (i.e., 0.266 lb a.i./A), i.e., prey of the AWS were assumed to be exposed on treated areas. Other values in Table 3-3 reflect lower maximum application rates for thiamethoxam but still assumed that prey of the AWS are exposed on treated areas rather than in nearby downwind areas. For example, two foliar applications are permitted on grapes at a rate of 0.055 lb a.i./A with a 14-day retreatment interval. Assuming a foliar half-life of 35 days, as was the case in the draft BE, the cumulative application rate after the second application would be 0.097 lb a.i./A which translates to the predicted mean arthropod concentration of 6.28 mg a.i./kg ww cited in Table 3-3 for grapes.

Table 3-3 Estimated mean arthropod concentrations of thiamethoxam in habitats of the Alameda whipsnake. All data are from the draft BE (EPA, 2021).

Use Pattern	*Mean Arthropod Concentration (mg a.i./kg ww)*
CONUS_Poultry Litter	17.3
CONUS_Open Space Developed	17.3

Table 3-3 Estimated mean arthropod concentrations of thiamethoxam in habitats of the Alameda whipsnake. All data are from the draft BE (EPA, 2021).	
Use Pattern	***Mean Arthropod Concentration (mg a.i./kg ww)***
CONUS_Developed	17.3
CONUS_Grapes	6.28
CONUS_Other Grains	7.66
CONUS_Other Crops	17.3
CONUS_Vegetables and Ground fruit	10.9
CONUS_Field Nurseries	17.3
CONUS_Other Orchards	17.3
CONUS_Other Row Crops	6.08
CONUS_Citrus	11.2
CONUS_Cotton	7.80
Maximum Estimated Environmental Concentration	17.3

The effects metric used to estimate risk to prey of the Alameda whipsnake is the most sensitive 48-hour LD50 of 0.032 mg a.i./kg bw for the Asiatic honey bee (*Apis cerana*) exposed via contact to thiamethoxam (see page 42 in chapter 2 of the draft BE). This effects metric is lower than the NOAELs and LOAELs for other terrestrial invertebrates.

The Endangered Species Act compels the EPA to use the "best available data" to assess risk to listed species. The LAA conclusion for the AWS is the result of several unreasonable assumptions. The information discussed below constitutes the highest quality and most relevant data and most scientifically defensible approach to determine whether thiamethoxam is likely or not likely to adversely affect the Alameda whipsnake via effects to its prey.

3.3.3 Critique of Draft BE Assessment

The draft BE assessment for the AWS was inaccurate for two major reasons: (1) the assessment assumed that the prey of the AWS occur exclusively on treated areas immediately after application of the flowable formulation, and (2) the EPA assumed that effects to terrestrial invertebrates would ultimately adversely affect the AWS despite its near obligate dependency on western fence lizards for prey. We explore each of these issues below.

Proximity of Alameda Whipsnake Habitat to Areas Where Thiamethoxam May Be Applied

The AWS inhabits local variations of chaparral, such as coastal sage scrub and northern coastal scrub, habitats that are not conducive to agriculture because chaparral soils have low nutrient levels and range from deep, weakly developed soils to shallow, rocky soils (https://www.conserve-energy-future.com/chaparral-biome.php). Temperatures tend to be very hot during the growing season (>100° F) but can be quite cold at night.

A proximity analysis was conducted which demonstrated that agricultural crops are not found near the species range of the AWS. The proximity analysis for the AWS included the agricultural use patterns that the EPA (2021) deemed to be LAA for prey of the listed species (see Table 3-3). Proximity distances from all areas using a 30 m by 30 m discretization within the AWS range to the nearest potential use site represented by crop footprints were calculated and used to create proximity probability distributions. The spatial data sources required for this analysis are from Frank et al. (2020).

Spatial analyses were conducted for each year from 2014 to 2018 and each crop group independently. The result provides the closest Euclidean distance from every 30-m pixel within the AWS species range boundary to the nearest potential thiamethoxam use site. The analysis conservatively assumed that a potential use site located within the AWS species range is actual habitat for the species. The distance calculation was capped at a maximum distance of 2,500 m (=8202.5 feet), which is well beyond the distance for which the EPA assumes zero spray drift for ground and aerial applications. The Euclidean distance results from the spatial processing were transformed from the spatial to the frequency domain. The resulting proximity distributions describe the fraction of the AWS species range is within a specific distance to a nearest use site. To be conservative, we relied on the 99th percentile proximity distances (i.e., 99% of the species range is located at even further distances) for the agricultural crop groups included in Table 3-3. As expected, the results indicate that the 99th percentile proximity distances from the AWS species range to agricultural crop footprints were large, i.e., 2,271.2 feet for vegetables and ground fruit to >8205.5 feet for other crops. except for vegetables and ground fruit, the 99th proximity distances exceed the maximum distances beyond which the EPA assumes zero spray drift for aerial (i.e., 2600 feet) and ground (i.e., 1000 feet) applications. At 2,271.2 feet, the EPA's spray drift model (i.e., AgDrift) estimates an upper bound fraction of applied of 0.00184 for aerial application to vegetables and ground fruit assuming a medium to coarse droplet size. The corresponding mean arthropod concentration for the vegetables and ground fruit use pattern is 0.0201 mg a.i./kg ww which is below the most sensitive 48-hour contact LD50 of 0.032 mg a.i./kg bw for the Asiatic honey bee. The mean arthropod concentration for all other agricultural use patterns, given the 99th proximity distances, is zero.

The above analysis has not been done for non-agricultural use patterns because of data limitations. However, the results would be similar for poultry litter given that the litter is applied as a soil amendment to crop fields. As noted earlier, usage of flowable thiamethoxam for non-agricultural use patterns is quite low in the United States.

Alameda Whipsnake Diet

Field-captured AWS were found to feed exclusively on lizards (including western fence lizards and western skink) based on stomach content analyses conducted by Swaim (1994). Thus, the EPA should have estimated concentrations in herptiles for its dietary assessment. Those concentrations should then have been compared to the thiamethoxam acute effects metric for birds (given the absence of toxicity data for herptile apical endpoints – see Chapter 2 of the draft BE). The EPA's T-HERPS model could have been easily adapted for such an analysis. Given the lack of direct effects predicted for the AWS in the draft BE, it seems likely that their herptile prey would similarly be unaffected.

3.3.4 Conclusions

The major threats to the AWS are loss, alteration and fragmentation of their required chaparral habitat (FWS, 2021a). Pesticides, including thiamethoxam, are not considered to be a threat. The evidence provided herein indicates that use of thiamethoxam is not likely to affect the availability of terrestrial insect prey, a dietary item infrequently consumed by the AWS. The EPA (2021) provided no information or analysis to determine the potential effects of thiamethoxam to the herptile prey upon which the AWS depends, i.e., the western fence lizard. The EPA (2021) found no concern for direct effects of thiamethoxam to the AWS.

3.4 Salt Marsh Harvest Mouse

Synopsis

- The salt marsh harvest mouse (SMHM) is a rodent endemic to the emergent wetlands of San Francisco Bay and its tributaries.
- The diet of the SMHM consists of seeds, grasses, leaves, plant stems, forbs, and insects. The species typically consumes fresh green grasses in the winter and pickleweed and saltgrass throughout the rest of the year
- The EPA (2021) determined that there were indirect adverse effects to the SMHM from 12 use patterns including poultry litter, open space developed, developed, grapes, other grains, other crops, and vegetables and ground fruit for the flowable formulation of thiamethoxam.
- No direct effects of thiamethoxam to the SMHM were predicted for any use pattern. The basis for the Likely to Adversely Affect (LAA) conclusion for this species was due to predicted effects to terrestrial invertebrate prey that occur in treated areas.
- The brackish marsh habitat of the SMHM is not found near agricultural crops. When proximity to potential treated areas is considered, there are no risk concerns for terrestrial invertebrate prey of the SMHM.
- Further, the primary dietary items of the SMHM are fresh green grasses, pickleweed and saltgrass, not terrestrial invertebrates. The EPA did not assess potential risks to the broadleaf plants and grasses upon which the SMHM depend for food and habitat. Given that thiamethoxam is practically non-toxic to terrestrial plants, there is no concern for effects to dietary items of the SMHM.

- In the Status of Species (SOS) review, the FWS did not identify pesticides as a threat to the SMHM.
- The available information indicates that a "Not Likely to Adversely Affect" conclusion is appropriate for the salt marsh harvest mouse for thiamethoxam use patterns within its range.

3.4.1 Status of Species Information

The SMHM (*Reithrodontomys raviventris*) is a rodent in the family Muridae (subfamily Sigmodontinae) (FWS, 2010a). There are two subspecies of SMHM: *Reithrodonomys raviventris halicoetes* (northern subspecies) and *Reithrodonomys raviventris raviventris* (southern subspecies) (FWS; 1984; Brylski, 1999; Sustaita et al., 2011).

The SMHM is endemic to the emergent wetlands of San Francisco Bay and its tributaries (Bias and Morrison, 1999) (Figure 3-3). The species is generally restricted to saline or brackish marsh habitats around the San Francisco Bay Estuary and is found in mixed saline/brackish portions Suisun Bay area. SMMH have also been found in one brackish area in the southern South San Francisco Bay (FWS, 2010a). The northern subspecies is found in the northern part of the Marin Peninsula throughout the Petaluma, Napa and Suisun Bay marshes, and in northern Contra Costa County in California. The marsh between Sonoma Creek and Mare Island provides an important refuge for this subspecies (FWS, 1984). The southern subspecies inhabits the areas from San Mateo County and Alameda County south along both sides of San Francisco Bay to Santa Clara County as well as isolated areas in Marin and Contra Costa Counties (Brylski, 1999).

The SMHM's primary habitat is pickleweed (*Salicornia virginica*) dominated vegetation. The value of pickleweed habitat increases with its depth, density, and degree of intermixing with fat hen (*Chenopodium album*) and alkali heath (*Frankenia salina*) (FWS, 2021a). These stands remain mostly un-submerged during periods of flooding. The preference for this type of habitat is most likely due to year-round cover from predators, use of pickleweed as a food source, competition with other small mammals, and escape from flooding (Fisler 1965; Geissel et al., 1988; Bias and Morrison, 1999).

SMHM are mainly nocturnal (Fisler, 1965; Brylski, 1999). Their diet consists of seeds, grasses, leaves, plant stems, forbs, and insects (FWS, 1984; Brylski, 1999). Diet varies seasonally based on the availability of vegetation. SMHM typically consume fresh green grasses in the winter and pickleweed and saltgrass throughout the rest of the year (Fisler, 1965). The mice have adapted to tolerate high salinities in both their food and drinking water. The northern subspecies can drink pure sea water, whereas the southern species prefers moderately salty water (Fisler, 1963; Haines, 1964).

The major threats to the SMHM are habitat loss and alteration of the vegetation zones of San Francisco Bay marshes, as the species has very specific habitat requirements (Shellhammer and Duke, 2010; Geissel et al., 1988; FWS, 1984, 2010a). Approximately 80% of the SMHM's historic tidal marsh habitats have been destroyed and many of those that remain support few to no mice due to filling, diking, subsidence, changes in water salinity and vegetation, non-native species invasions, and sea level rise associated with global climate change and pollution (Bias and Morrison, 1999; FWS, 2010a). The habitat suitability of many marshes is also limited by small size, fragmentation, and lack of vital features such as sufficient escape habitat from predators. Pesticides are not listed as a threat to the SMHM (FWS, 2021a).

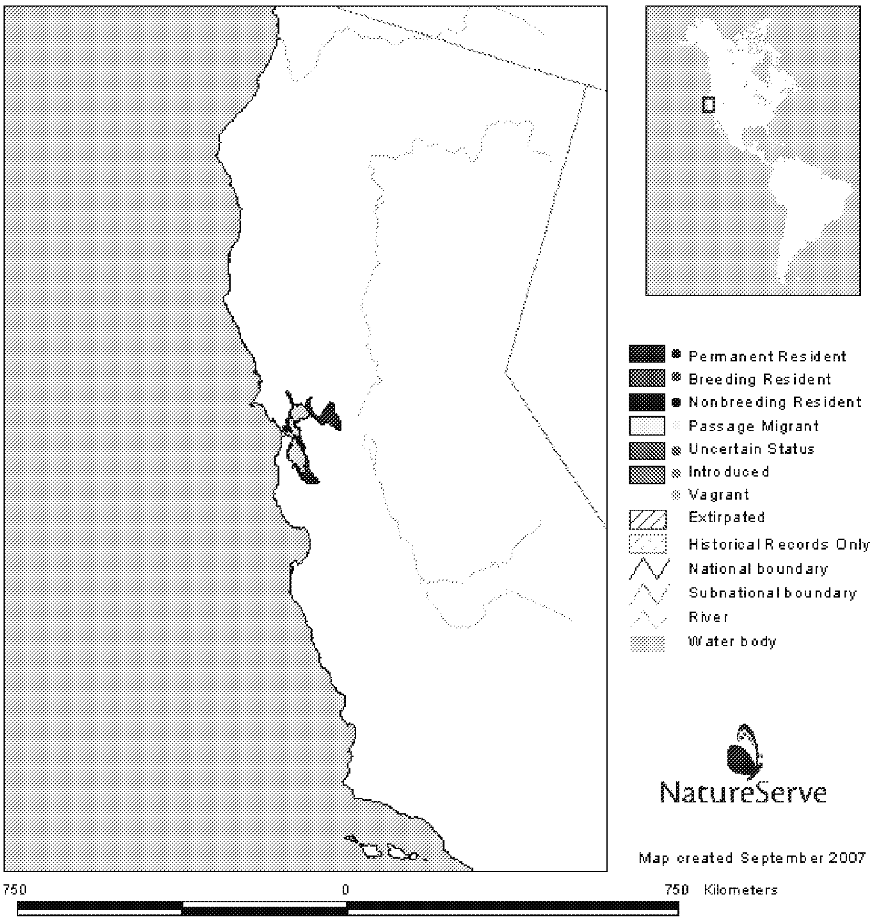

Figure 3-3 Distribution of the salt marsh harvest mouse (from NatureServe, 2012).

3.4.2 Draft Biological Evaluation Summary

The draft LAA conclusion for the SMHM is entirely due to predicted effects of thiamethoxam to terrestrial insect prey (EPA, 2021). The MAGtool exposure estimates for use patterns at potential risk are summarized in Table 3-4. The exposure estimates are mean estimated environmental concentrations in arthropods from the nomogram included in the T-REX model. As with the Alameda whipsnake, the highest value of 17.3 mg a.i./kg ww was derived for six use patterns (i.e., poultry litter, open space developed, developed, other crops, field nurseries, other orchards) (Table 3-4). This value is associated with the maximum label application rate for the flowable formulation of thiamethoxam (i.e., 0.266 lb a.i./A), i.e., prey of the SMHM were assumed to be exposed on treated areas. Other values in Table 3-4 reflect lower maximum application rates for thiamethoxam but still assumed that insect prey of the SMHM are exposed on treated areas rather than in nearby downwind areas.

Table 3-4 Estimated mean arthropod concentrations of thiamethoxam in habitats of the salt marsh harvest mouse. All data are from the draft BE (EPA, 2021).

Use Pattern	*Mean Arthropod Concentration (mg a.i./kg ww)*
CONUS_Poultry Litter	17.3
CONUS_Open Space Developed	17.3
CONUS_Developed	17.3
CONUS_Grapes	6.28
CONUS_Other Grains	7.66
CONUS_Other Crops	17.3
CONUS_Vegetables and Ground fruit	10.9
CONUS_Field Nurseries	17.3
CONUS_Other Orchards	17.3
CONUS_Other Row Crops	6.08
CONUS_Citrus	11.2
CONUS_Cotton	7.80
Maximum Estimated Environmental Concentration	17.3

The effects metric used to estimate risk to prey of the SMHM is the most sensitive 48-hour LD50 of 0.032 mg a.i./kg bw for the Asiatic honey bee (*Apis cerana*) exposed via contact to thiamethoxam (see page 42 in chapter 2 of the draft BE). This was the same effects metric used for prey of the AWS.

The Endangered Species Act compels the EPA to use the "best available data" to assess risk to listed species. The LAA conclusion for the SMHM is the result of same unreasonable assumptions identified for the Alameda whipsnake. The information discussed below constitutes the highest quality and most relevant available data and most scientifically defensible approach to determine whether thiamethoxam is likely or not likely to adversely affect the SMHM via effects to its prey.

3.4.3 Critique of Draft BE Assessment

The draft BE assessment for the SMHM was inaccurate for two major reasons: (1) the assessment assumed that their prey occur exclusively on treated areas immediately after application of the flowable formulation, and (2) the EPA assumed that effects to terrestrial invertebrates would ultimately adversely affect the SMHM despite plants being the primary dietary item for this species. We explore each of these issues below.

Proximity of Salt Marsh Harvest Mouse Habitat to Areas Where Thiamethoxam May Be Applied

The SMHM is endemic to the emergent wetlands of San Francisco Bay and its tributaries and is generally restricted to saline or brackish marsh habitats. Such habitats are not conducive to agricultural crops, nor would they be developed.

A proximity analysis was conducted as described in Section 3.3.3 for the SMHM and the use patterns listed in Table 3-4. As expected, the results indicate that the 99th percentile proximity distances from the SMHM species range to agricultural crop footprints were large, i.e., 1179.5 feet for citrus to >8205.5 feet for other crops. The 99th proximity distances exceed the maximum distances beyond which the EPA assumes zero spray drift for aerial (i.e., 2600 feet), airblast (1800 feet) and ground (i.e., 1000 feet) applications for other grains, other crops, and cotton. At 1179.5 feet, the EPA's spray drift model (i.e., AgDrift) estimates an upper bound fraction of applied of 0.0000474 for airblast application to citrus orchards. The corresponding mean arthropod concentration for citrus use pattern is 0.00053 mg a.i./kg ww which is nearly two orders of magnitude below the most sensitive 48-hour contact LD50 of 0.032 mg a.i./kg bw for the Asiatic honey bee. The mean arthropod concentration for ground applications to all other agricultural use patterns, given the 99th proximity distances, is zero. For aerial application, only one use pattern produced a mean arthropod concentration that slightly exceeded the acute effects metric for Asiatic honey bees, i.e., vegetables and ground fruit (0.0402 mg a.i./kg ww). Given that insects are a minor part of the diet of the SMHM and the conservativeness of the EPA's AgDrift spray drift model (Moore et al., 2021), the slight exceedance is not a concern for the diet of the SMHM

The above analysis was not done for non-agricultural use patterns because of data limitations. However, the results would be similar for poultry litter given that the litter is applied as a soil amendment to crop fields. As noted earlier, usage of flowable thiamethoxam for non-agricultural use patterns is quite low in the United States.

Salt Marsh Harvest Mouse Diet

The diet of the SMHM consists of seeds, grasses, leaves, plant stems, forbs, and insects (FWS, 1984; Brylski, 1999) with the primary dietary items being fresh green grasses in the winter and pickleweed and saltgrass the rest of the year (Fisler, 1965). Insects are an infrequently consumed dietary item. Thus, it is unclear why the EPA focused its entire dietary assessment on insects. Thus, the EPA should have estimated concentrations in broadleaf foliage given that that is the primary dietary item when thiamethoxam is most likely to be applied. The EPA (2021) found that thiamethoxam and clothianidin have very low toxicity to terrestrial plants. The only meaningful biological effect was observed for oilseed rape at an application rate of 0.26 lb a.i./A in a vegetative vigor test (see section 13.2 of chapter 2 in the draft BE). Expected application rates on broadleaf foliage in SMHM habitats would be orders of magnitude below this effects metric at the 99th percentile proximity distances derived for the agricultural use patterns listed in Table 3-4.

3.4.4 Conclusions

The major threats to the SMHM are habitat loss and alteration of the vegetation zones of San Francisco Bay marshes (Shellhammer and Duke, 2010; Geissel et al., 1988; FWS, 1984, 2010a, 2021a). Pesticides, including thiamethoxam, are not considered to be a threat (FWS, 2021a). The evidence provided herein indicates that use of thiamethoxam is not likely to affect the availability of terrestrial insect prey, a dietary item infrequently consumed by the SMHM. The EPA (2021) provided no information or analysis to determine the potential effects of thiamethoxam to the terrestrial plants upon which the SMHM depends for nearly all of its diet. The EPA (2021) found no concern for direct effects of thiamethoxam to the SMHM.

3.5 Fragrant Prickly-apple

Synopsis

- The Fragrant prickly-apple (FPA) is a tree cactus plant species found in Florida. The primary threats to this species are habitat loss, fragmentation, and changes in land use.
- The pollinators for the FPA have not been identified, however, hawk moths and several species of beetles are likely involved.
- The EPA (2021) determined that there were indirect adverse effects to the FPA from 11 use patterns including poultry litter, other grains, field nurseries, citrus, open space developed, developed, other crops and vegetables and ground fruit for the flowable formulation of thiamethoxam.
- No direct effects of thiamethoxam to the FPA were predicted for any use pattern. The basis for the Likely to Adversely Affect (LAA) conclusion for this species was due to predicted effects to terrestrial pollinators that occur in treated areas.
- Given the proximity of agricultural use patterns, there is a low likelihood of adverse effects to pollinators of the FPA. Limited toxicity data indicate that pollinators of the FPA may be tolerant of thiamethoxam exposure.
- The FWS has not identified insecticides as a threat to the FPA.
- The available information indicates that a "Not Likely to Adversely Affect" conclusion is appropriate for the fragrant prickly-apple for thiamethoxam use patterns within its range.

3.5.1 Status of Species Information

The FPA (*Cereus eriophorus var. fragrans*) is a tree cactus plant species found in southeastern Florida. It was listed as endangered in the United States in 1985 (FWS, 2010b). Pollinators for the FPA have not been identified. Similar cacti species are pollinated by moths, such as the hawk moths, and several species of beetle have been observed in the flowers of this plant shortly after opening (FWS, 2021b; Moore, 2011). The most recent population estimate for the FPA is 1,163 plants located in seven populations (i.e., six natural and one introduced) in St. Lucie, Indian River, Brevard, and Volusia counties (FWS, 2021b). The FPA is presently only found in sand pine scrub habitat and in xeric hammock, coastal strand, and coastal hammocks along the Atlantic Coastal Ridge (FWS, 2021b). Figure 3-4 shows the current range of the FPA

The principal threats to the species are habitat loss, fragmentation, and changes in land use (FWS, 2021b). In addition to habitat loss, collecting by cactus enthusiasts may have led to losses of additional plants. Many FPA individuals are found on or near the right-of-way of the Florida East Coast Railroad. Herbicides used in maintaining railroad rights-of-way may affect cacti near the tracks. Off-road vehicle use in FPA habitat is also known to impact plants. Insecticides, including thiamethoxam, have not been cited as a threat to the species.

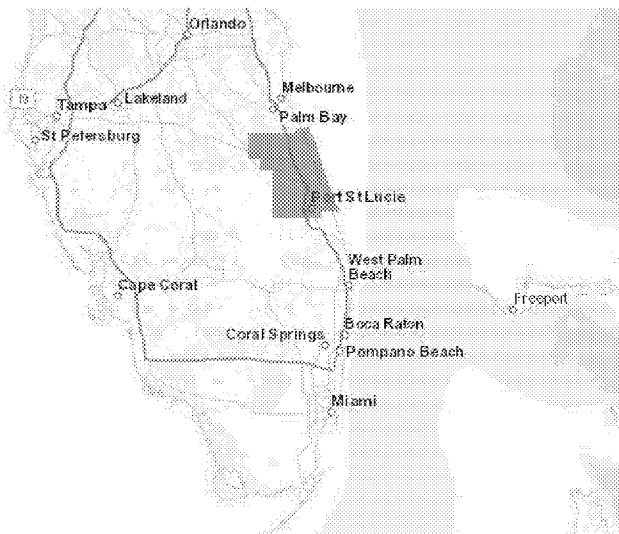

Figure 3-4 Fragrant prickly apple current species range (green).

3.5.2 Draft Biological Evaluation Summary

The draft LAA conclusion for the FPA is entirely due to predicted effects of thiamethoxam on the pollinators upon which the species depends. The MAGtool exposure estimates for use patterns at potential risk are summarized in Table 3-5. The exposure estimates are mean estimated environmental concentrations in arthropods from the nomogram included in the T-REX model. As with the AWS and the SMHM, the highest value of 17.3 mg a.i./kg ww was derived for six use patterns (i.e., poultry litter, open space developed, developed, other crops, field nurseries, other orchards) (Table 3-5). This value is associated with the maximum label application rate for the flowable formulation of thiamethoxam (i.e., 0.266 lb a.i./A), i.e., pollinators of the FPA were assumed to be exposed on treated areas. Other values in Table 3-5 reflect lower maximum application rates for thiamethoxam but still assumed that the insect pollinators of the FPA are exposed on treated areas rather than in nearby downwind areas.

Table 3-5 Estimated mean arthropod concentrations of thiamethoxam in habitats of the fragrant prickly-apple plant. All data are from the draft BE (EPA, 2021).

Use Pattern	*Mean Arthropod Concentration (mg a.i./kg ww)*
CONUS_Poultry Litter	17.3
CONUS_Other Grains	7.66
CONUS_Field Nurseries	17.3
CONUS_Citrus	11.2
CONUS_Developed	17.3
CONUS_Open Space Developed	17.3
CONUS_Other Crops	17.3
CONUS_Vegetables and ground fruit	10.9
CONUS_Grapes	6.28
CONUS_Other Orchards	17.3
CONUS_Other Row Crops	6.08
Maximum Estimated Environmental Concentration	17.3

The effects metric used to estimate risk to prey of the SMHM is the most sensitive 48-hour LD50 of 0.032 mg a.i./kg bw for the Asiatic honey bee (*Apis cerana*) exposed via contact to thiamethoxam (see page 42 in chapter 2 of the draft BE). This was the same effects metric used for prey of the AWS and the SMHM.

The Endangered Species Act compels the EPA to use the "best available data" to assess risk to listed species. The LAA conclusion for the FPA is the result of same unreasonable assumptions identified for the AWS and the SMHM. The information discussed below constitutes the highest quality and most relevant data and most scientifically defensible approach to determine whether thiamethoxam is likely or not likely to adversely affect the FPA via effects to the pollinators of this species.

3.5.3 Critique of Draft BE Assessment

The draft BE assessment for the FPA was inaccurate for two major reasons: (1) the assessment assumed that the pollinators of the FPA occur exclusively on treated areas immediately after application of the flowable formulation, and (2) the EPA assumed that effects to terrestrial invertebrates would ultimately adversely affect the FPA even though the suspected pollinators of this species are likely less sensitive to thiamethoxam than the most sensitive tested species. We explore each of these issues below.

Proximity of Fragrant Prickly-apple Habitat to Areas Where Thiamethoxam May Be Applied

The FPA is presently only found in sand pine scrub habitat and in xeric hammock, coastal strand, and coastal hammocks along the Atlantic Coastal Ridge (FWS, 2021b). The majority of FPA cacti occur in publicly owned lands that are managed for conservation (FWS, 2021b). The known sites are limited to St. Lucie sand which is excessively well drained and where the water table is normally deeper than 3 m. Water capacity, fertility, and organic matter content are all very low. Therefore, the currently occupied FPA habitats are not conducive to agricultural crops, nor are they in areas where agriculture and development would be permitted.

A proximity analysis was conducted as described in Section 3.3.3 for the FPA and the use patterns listed in Table 3-5. The results indicate that the 99th percentile proximity distances range from 307.8 feet for vegetables and ground fruit to >8202.5 feet for citrus and for other crops. At 307.8 feet, the EPA's spray drift model (i.e., AgDrift) estimates an upper bound fraction of applied of 0.0158 for aerial application to vegetables and ground fruit assuming a medium to coarse droplet size. The corresponding mean arthropod concentration is 0.172 mg a.i./kg ww which exceeds the most sensitive 48-hour contact LD50 of 0.032 mg a.i./kg bw for the Asiatic honey bee. No other agricultural use patterns have arthropod concentrations that exceed the acute effects metric, including ground application to vegetables and ground fruit. Given the conservativeness of the EPA's AgDrift spray drift model (Moore et al., 2021), the single exceedance is not a concern for pollinators of the FPA.

The above analysis was not done for non-agricultural use patterns (i.e., open space developed) because of data limitations. However, the results would be similar for poultry litter given that the litter is applied as a soil amendment to crop fields. As noted earlier, usage of flowable thiamethoxam for non-agricultural use patterns is quite low in the United States.

Sensitivity of Pollinators to Thiamethoxam

Toxicity studies with thiamethoxam on moths are limited. However, Jones et al. (2012) showed that dietary administration of thiamethoxam to oriental fruit moth (*Grapholita molesta*) was less toxic compared to other insecticides. Thiamethoxam is not registered for use to control the oriental fruit moth because it is ineffective at controlling this pest based on field observations (Jones et al., 2012). Studies by Krishnan et al. (2020, 2021) determined the toxicity of thiamethoxam to various life stages of the monarch butterfly, *Danaus plexippus*. Monarch eggs and larvae were determined to be more sensitive than pupae and adults (Krishnan et al., 2021). The lowest contact and dietary LD50 values were for larvae, i.e., 6.1 mg a.i./kg bw and 3.5 mg a.i./kg diet, respectively. These values are over two orders of magnitude higher than the Asiatic honey bee, *Apis ceranae*, contact LD50 of 0.032 mg a.i.kg bw and the European honey bee, *Apis* *mellifera*, dietary LC50 of 0.014 mg a.i./kg diet that were used in the MAGtool. There are no toxicity data available from acceptable quality studies for beetles exposed to thiamethoxam.

Honey bees do not pollinate the FPA. Therefore, even a significant reduction in availability of honey bees in the FPA range would have no effect on this species.

3.5.4 Conclusions

The future of the FPA is highly vulnerable primarily because of loss of habitat. The Fish and Wildlife Service has not cited insecticides, including thiamethoxam, as a threat to the species. The evidence provided herein indicates that use of thiamethoxam is unlikely to have an effect on the availability of the pollinators upon which the FPA depends for reproduction. The EPA (2021) found no concern for direct effects of thiamethoxam to the FPA.

4.0 OVERALL CONCLUSIONS

In the draft BE for thiamethoxam, the EPA (2021) assigned May Affect/Likely to Adversely Affect (MA/LAA) determinations for 1,208 out of 1,821 listed species that entered the Revised Method process for indirect effects alone. Our review of the draft BE and our five case studies indicated that there was little to no scientific basis for the MA/LAA determinations for many of the listed species for indirect effects. The issues in the draft BE included: not considering species-specific diets and habitats in estimating exposure to the receptor groups upon which listed species depend; estimating risk to inconsequential prey items rather than major prey items; lack of consideration of other lines of evidence including monitoring data and higher tier mesocosm studies; and reliance on conservative assumptions regarding proximity of dietary items, the amount of usage near species ranges, and other aspects of the exposure models. We recommend that the EPA consider a more realistic assessment approach for thiamethoxam in the final BE. Otherwise, many listed species that are at negligible risk from exposure to thiamethoxam will require refined assessments from the Services in their forthcoming Biological Opinion.

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